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OF

OPHTHALMOLOGY

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BY

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VOL. XLIX. NO. 1.

ARCHIVES OF OPHTHALMOLOGY.

SUGGESTIONS REGARDING THE TEACHING OF OPHTHALMOLOGY.[1]

BY DR. F. H. VERHOEFF, BOSTON, MASS.

ALL of us will agree, I am sure, that the training of ophthalmologists up to the present time has been highly unsatisfactory. The men have been thrown largely upon their own resources, compelled to teach themselves and, above all, provided with imperfect facilities for so doing. To have been compelled to teach themselves has not been altogether unfortunate, and I think that in the future also the most eminent ophthalmologists will continue to be largely self taught, but I hope that their tasks will be rendered easier and that they will reach still higher standards than in the past. It will never be possible "to make a silk purse out of a sow's ear" and one of our endeavors at the outset should be to exclude the unfit and attract men of natural ability into our specialty.

The suggestions that I have to make on the teaching of ophthalmology are based partly on my experience as a teacher, and partly on my experience in the practice of ophthalmology. As a teacher I have acquired certain views in regard to methods of instruction, as a practitioner, my own needs as well as those of colleagues have indicated to me some of the subjects that should be taught.

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[1] Read at meeting of Section on Ophthalmology, New York Academy of Medicine, October, 1919.

Students requiring or desiring instruction in ophthalmology divide themselves into four main groups, namely, (a) The medical undergraduates; (b) The general practitioners who desire to take up the practice of ophthalmology; (c) The practicing ophthalmologists who desire to make up deficiencies in their training; (d) The recent medical graduates who desire to qualify themselves for the practice of ophthalmology. I shall discuss the problems relating to the instruction of each of these groups in order.

(a) The medical undergraduates: I shall not discuss at length the undergraduate course in ophthalmology since it has but little value to the students who are later to take up the practice of this specialty. In the cases of certain of these students it could, perhaps, advantageously be dispensed with and other courses substituted. It is pertinent, however, to remark here that the undergraduate course should give the students such a comprehensive though general view of the subject that they will realize what an interesting branch of medicine ophthalmology is, and that its mastery requires a thorough knowledge of all the fundamental principles of medical science. If the undergraduate students are thus impressed a larger percentage of high grade students will no doubt decide upon an ophthalmological career.

(b) The general practitioners who desire to take up the practice of ophthalmology: Usually they are men who have failed in their profession or have become tired of it, and have turned to ophthalmology not because of any special liking for this specialty, but because they regard special practice as an easy way to make a living. Many of these men are imbued with the idea that they can become competent ophthalmologists by taking a six weeks' post-graduate course. Under present conditions they cannot very well be excluded from these courses, but when there are established postgraduate schools of ophthalmology worthy the name they should be compelled to take the complete course therein. In this connection I may add that in my opinion it is not desirable for a man to take up general practice before beginning the practice of ophthalmology. For, while I would not say that the time so spent is entirely wasted, it can certainly be employed otherwise to far greater advantage.

(c) The practicing ophthalmologists who desire to make up deficiencies in their training. Since at present there are no qualifications required for special practice, other than a license to practice general medicine, there are ophthalmologists of all possible grades in this country. Many of them are unworthy of consideration and should be excluded from special practice, but others through natural ability and industry have developed into able practitioners. Many of the latter, finding themselves deficient along certain lines, take special courses offered at various medical schools or hospitals, and more of them would do so if such courses were adapted to their needs. In any scheme of ophthalmic instruction provision should, if possible, be made for these men. However, this should not be done if it interfered in any way with the regular curriculum of the graduate school. No doubt after the latter had become thoroughly established, this problem would solve itself by the process of evolution. Perhaps such courses can be limited to the summer months. In the future probably the demand for them will gradually diminish or disappear as the new set of ophthalmologists reach the ascendancy in numbers.

(d) The recent medical graduates who desire to qualify themselves for the practice of ophthalmology: From the standpoint of its significance to the community, I regard this as the most important problem connected with ophthalmology to-day. For upon the character of the training of the ophthalmologist largely depends the service he will render the community, not only as a practitioner, but also as an investigator and teacher. The attempt of the American Board for Ophthalmic Examinations to set up a minimum standard of qualifications for the practice of ophthalmology is most praiseworthy, but under present conditions it seems to me it is almost like placing the cart before the horse. For if the minimum requirements were set as high as they should be, few of the candidates would be able to meet them owing to the impossibility of obtaining the necessary instruction. It is, therefore, of prime importance that schools should be established for such instruction. These schools would not only make it possible to place the minimum standard high, but would ultimately raise the standard of the leaders of ophthalmology. Since the younger men would strive to emulate the leaders, the general standard of ophthalmology in this country would rise to a higher level.

The following plan that I have to suggest for a graduate school of ophthalmology will no doubt be found far from perfect. I feel, however, that it is something to build upon, and will be perfected by the process of evolution or trial and error, if put into execution.

PLAN FOR GRADUATE SCHOOL OF OPHTHALMOLOGY.

Requirements for admission:

(a) A degree from an approved medical school which requires for metriculation at least two years of collegiate work. A four years' college course is not insisted upon because in many cases this would unreasonably prolong the time before the beginning of practice. The college work, however, should include courses in higher algebra, plane and solid geometry, trigonometry, physics, and chemistry. A reading knowledge of French and German should be recommended if not required.

(b) Such practical clinical experience in general medicine, surgery, dermatology, syphilology, oto-laryngology, and neurology, as can be obtained in the out-patient clinics of a large general hospital within six months. It should be allowable for the student to divide this work, taking three months' work in the summer before entering the school, and three months' work the following summer or the summer after the hospital year.

In place of requirement (b) there may be substituted,

One year's experience as pathological interne or assistant in pathology at an approved hospital or medical school.

Or, one year's experience as assistant in physiology at an approved medical school.

Or, one year's experience as interne in an approved general hospital.

I have purposely made these requirements elastic because I believe it not desirable to attempt to cast, as it were, all the students in the same mold. By allowing students to follow their own inclinations as far as possible they will later be better able to specialize in certain subjects connected with ophthalmology and as research workers to contribute materially to the advancement of ophthalmic science.

I feel strongly that the students should be discouraged from accepting interne-ships in general hospitals. While no doubt they learn, in this way, better than in any other, a few things that will later be useful to them, they do so at too great a sacrifice of time and energy. During this period, when they are best able to acquire new knowledge, they are seeing a very limited variety of cases, are almost out of touch with the ophthalmic viewpoint, and are too fatigued by the stress of routine work to read or to permit their original ideas to come into play. Moreover, they are learning many things that will not be of the slightest value to them in special practice. On the other hand, in a large out-patient clinic, they become familiar with a great variety of conditions which may later present themselves in connection with their special practice.

PLAN OF INSTRUCTION.

The course would lead to the degree of Doctor of Ophthalmology (Oph.D.) and occupy two years. The first year, to be known as the academic year, would be devoted both to clinical and laboratory work, and in the case of specially qualified students, to a certain amount of research. During the second, or hospital year, the student would be required to serve as ophthalmic interne or assistant in an approved hospital.

The academic year: The student each morning would follow the practical clinical work of the hospital from 9 A.M. to 12 M., three days a week attending the out-patient clinic and the other days attending the operations and studying house cases. In this way the student would be kept in touch with clinical work throughout his course. This would make all of the work more interesting and significant than otherwise would be the case, and at the same time enhance his clinical knowledge. Moreover, it is impossible to concentrate clinical teaching within a short period of time, since a sufficient number of cases are not available for this purpose.

The laboratory work would be carried on chiefly in the afternoons, and would be arranged tentatively as follows: Gross anatomy of the head, including the accessory sinuses, orbit, and central nervous system; normal histology and embryology of the eye, two months. Pathological histology, experimental pathology, bacteriology of the eye, operative work on cadavers and animals seven months, three days a week. Physiological optics, errors of refraction, motor anomalies, perimetry, neurology of the eye, seven months, two days a week.

The Hospital Year: This should preferably follow the academic year. At first, however, it may be found advisable to admit students to the academic year who have already served ophthalmic interne-ships, or whose clinical experience is equivalent to this. At the end of the academic year a certain number of students, the exact number depending upon local conditions, would be selected on the basis of their work to become internes in the hospital connected with the school. The others would be granted certificates indicating that they had completed the academic year and would then have to seek interne-ships elsewhere. An attempt should be made to secure coöperation on the part of other hospitals so that these men could be appointed without examination. On the completion of the hospital year, the degree of Doctor of Ophthalmology would be conferred.

If as seems improbable, it should turn out that the schools of ophthalmology could not on this plan graduate a sufficient number of ophthalmologists to supply the country, it might be necessary to abandon the hospital year as a requirement for the degree.

METHODS OF INSTRUCTION.

The classes should be small, each consisting perhaps of only eight students. Large classes could not be taught satisfactorily in the clinic and it would be impossible for all the members to obtain interne-ships. On account of the small size of the class, instruction could be given throughout by demonstrations, informal talks, assigned reading, and recitations. Courses of didactic lectures although often pleasing to the student, are generally of little real value and should be employed only when instructors who are exceptionally gifted as lecturers are available. A certain number of special lectures, however, should be given by various members of the hospital staff upon subjects upon which they are particularly well qualified to speak.

The time assigned to the laboratory courses no doubt would have to be modified to meet local conditions. At the outset the courses on the anatomy of the head and central nervous system, and possibly upon the neurology and embryology of the eye, may have to be given by the regular departments of anatomy, etc., in the medical school, on account of the impossibility of obtaining ophthalmologists qualified to give them. As soon, however, as graduates of the ophthalmic school can be obtained who desire to give these courses, it would be preferable for them to do so because they would have the ophthalmological point of view.

Research: At first no special provision for research work need be made. Until a student has received training equivalent to that afforded by the school it would be unlikely that he could conduct investigations of any real importance. Throughout the course the originality of the student should be fostered and students who show special ability and aptitude for research should later be appointed instructors in the school and permitted to carry on original investigations. Ultimately provision should be made for men to devote their entire time to investigation.

THE TEACHING STAFF.

This will no doubt present the most serious problem connected with the organization of the school. While almost all of the members of a hospital staff are willing to give a certain amount of time to clinical teaching, few are qualified to give such instruction as should be given and these few seldom can afford the necessary time and energy. Still greater difficulty will be encountered in obtaining teachers for the laboratory courses, for at present there are almost no men qualified to give them. Moreover, the men would have to sacrifice a large part of the time ordinarily given to private practice. The ideal solution of the problem would be to reorganize our hospital staffs so that they would include a certain number of men who devoted their entire time to hospital work and teaching. These men would have general charge of the teaching and would assign certain supplementary work of instruction to qualified members of the visiting staff. To begin with, however, the only practical solution, it seems to me, would be to select a number of younger men of special ability who would give a large part of their time to the work and teach themselves at the same time they were teaching the students. These men should be as few as possible so as to allow for expansion of the teaching force later when graduates of the school became available. Obviously, the solution of this problem will be influenced by local conditions.

To inaugurate and maintain such a school as I have outlined, adequate funds would be necessary. Since the classes would be small it is manifestly impossible that the fees paid by the students would be sufficient for the purpose. The public desires efficient service from ophthalmologists and therefore should provide the funds to ensure it, either directly or indirectly through some benevolent individual. It is a noteworthy fact that while relatively large sums have been contributed to further the advancement of other branches of medical science, ophthalmology has been sadly neglected. This may be due to the fact that its needs have not been sufficiently advertised, and all of us should therefore endeavor to remedy this state of things. The altruistic tendencies of the public which were so strikingly displayed during the period of the German menace, have apparently gone almost out of existence with the latter. It will now no doubt be necessary to appeal to the selfish and even purely commercial instincts of the public. However, by pointing out the economic loss that results from impaired vision, a strong plea can be made for ophthalmology upon these grounds alone.

SOME SUGGESTIONS IN POSTGRADUATE TEACHING OF OPHTHALMOLOGY.[1]

By Dr. MEYER WIENER, St. Louis, Mo.

THE whole problem of what is most needed in postgraduate teaching rests upon the question as to how well qualified is the average physician starting in to limit his practice to diseases of the eye,—what preliminary training he has had, and with what experience, both theoretical and clinical, he has been endowed in his special branch. Napoleon once said that in making an attack upon the enemy, the main object was to make it a successful attack, and in order to accomplish this, one must need use all of his available material,—men, cannon, and horses, and that all must be used to the greatest advantage. Thus, a young man, in preparing himself for any special branch in the practice of medicine, including ophthalmology, must first of all be well versed in the groundwork of medicine, including the fundaments, such as anatomy, chemistry, physiology, pathology, etc. How can one expect to learn to take care of diseased tissues, unless he has a thorough understanding of their very life, growth, and living functions and reactions? It is not any more essential for him to be an *expert* in the physiological laboratory or chemical laboratory than it is for the general planning the attack to have a detailed knowledge of the placing, sighting, and firing of each gun. It is all-important, however, that the general should know the range and destructive power of his guns, just as it is for our student to have a good general knowledge of the fundamental branches, so that he may summon his aids for help in emergency, or even in daily routine. In order to attain the greatest success he must utilize all of this knowledge acquired to the very best advantage. This point, I assume, is a generally recognized fact and can be passed over lightly.

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[1] Read at the meeting of Section on Ophthalmology, New York Academy of Medicine, October, 1919.

There seems, however, to be a wide divergence of opinion as to what method of procedure shall be employed to best equip the specialist for his future life work. I am judging this from various sources—from the courses outlined in the medical school, undergraduate departments and postgraduate departments; from the special postgraduate schools and courses; and lastly, from the knowledge acquired from having been thrown in unusually close contact with a large number of practicing ophthalmologists at Camp Greenleaf. All of them were supposedly well qualified in their specialty, but a large proportion was sadly deficient in general groundwork, and a still greater number was lacking in many of the constituent principles making for careful and efficient work. To those who have had the exceptional opportunity of conducting the examination for the certificate of ophthalmology, given by the American Board of Ophthalmic Examiners, has been revealed, to an unusual degree, the ability to determine the fitness, acquirements, and restrictions of a certain class of aspiring ophthalmologists. There is lacking in this group, however, certain men, successful and otherwise, who for various reasons have not seen fit to come before this examining body, and therefore the field of judgment has been, in a measure, limited. To Dr. de Schweinitz and myself, however, and our corps of associate instructors at Camp Greenleaf, I feel that an unusual occasion was offered to judge the fitness and inherent qualifications of the ophthalmologists who were sent to camp for training. These men were taken from all sources and localities,—from Alaska to California; from Florida to Maine. Among them were thoroughly capable men with national reputations, as well as others who, though perhaps enjoying a large and lucrative practice, were wholly unfit for their work.

The average course in ophthalmology embraces the teaching of external diseases of the eye, their symptoms and signs, diagnosis and treatment, and errors of refraction and muscle work and the use of the ophthalmoscope in a more or less complete manner. It also includes the various operations on the eye, and the usual operative methods employed. Some reach out still further and give a general outline of special anatomy, special physiology and pathology, and even, as in the University of Colorado, a course on physiological optics. The student is shown certain cases in the clinics, told, for instance, that this certain patient is afflicted with iritis, and given a talk on the symptoms of the disease and perhaps the differential diagnosis; and then treatment is outlined. Seldom is the opportunity given to the student to conduct the examination himself and arrive at a diagnosis after summing up his findings. I think that the most serious defect in the education of our ophthalmologists, next to the need of a fundamental education, has been the lack of a systematic method of examination of patients and training the power of observation. This includes not only external diseases, but ophthalmoscopic examination as well.

Our experience at Camp Greenleaf showed that practically no one entering the school could properly describe a fundus. I do not mean to imply that these student officers were unable to make an ophthalmoscopic diagnosis, for there were men who came to us who were as capable in general as perhaps any of the teaching staff, and much more so than some of them. But I maintain that they were not properly trained to accurately and systematically describe a fundus, which means that with such ability as they possessed, plus the proper system, they would have been even better men and perhaps have let fewer things slip by unnoticed.

For example, it was our custom to insist on the following routine in examination of the fundus:

(1) MEDIA: If opacities existed, describe location, size, and number, and if in the vitreous, whether fixed or floating.

(2) DISK: Its size, shape, color, outline, surface, excavation in detail as to size, depth, sloping or undermined walls, vessels perforating cup margins or following the sides; lamina cribrosa plain or obscured. Condition of scleral and choroidal ring, pigment deposits, etc.

(3) VESSELS: Size, actual and relative, color and contour, pulsation flexibility and reflex.

(4) LESIONS: Size, character, number and location, macular

region, foveal reflex, and periphery. It was impressed upon the student that in searching for lesions, he must follow some systematic method, such as following the four branches of the central vessels from the disk outward; a careful examination of the macular region and of the periphery, so as not to let any possible lesion escape notice. A case of fracture of the skull in a small boy was utilized to advantage before one of the sections, to demonstrate the importance of careful daily recording of the findings in detail, the disk outline being normal on the first examination, and showing progressive changes on each succeeding examination. In this case the first slight change was noticed within twelve hours after the first examination, before the report from the X-ray plate had been returned, making an almost positive diagnosis of fracture, confirmed later by the X-ray plate.

It has always been my firm conviction that after one or two cases have been demonstrated before a class, showing the method of routine examination, the students in turn should make examination of all other patients before the rest of the class, stating his findings as he progresses, and only guided by the instructor during the examination, so as to make certain that nothing is overlooked. In this manner the student gains self-confidence and reliance, while the attention of the rest of the class is held much closer, knowing that any one of them may be called upon to supply some point neglected by his brother student during the process of the examination.

If the student makes a routine examination of a patient, describing the general condition of the patient and in detail the appearance of the external lids, lid margins, sac, external muscular movements, width of the palpebral fissures, conjunctival surface of lids, retrotarsal fold, sclera, cornea, iris, pupillary reactions, tension, etc., how can he help but observe any and all pathological processes which may be present, and thus arrive at a correct diagnosis? For example, in describing the bulbar conjunctiva, it is required that he note not only redness, but the character of the redness, extent and location, etc., always impressing the necessity of systematic and careful routine. This point, to my mind, has been the one outstanding feature lacking in properly training our students of ophthalmology.

I am not offering a definite schedule for consideration, nor am I urging a fixed plan for what is necessary as to length of time a course of study should continue in order to include all of the essentials for making a competent oculist. The schedule in force at Camp Greenleaf was most carefully worked out as to what could be offered in a given number of hours. A certain proportion was allowed for didactic teaching and the rest divided into practical work, such as refraction, muscle work, perimetry, examination of clinical cases, ward work, records, operations, etc.

I believe a course could be worked out with these same principles for a basis. First, that no one should be admitted to this course without proper credentials or credits, just as he would be compelled to present in entering an accredited university for a degree,—in lieu of which he should pass a satisfactory entrance examination.

A six months course should be given during which the student's time should be wholly occupied from five to six hours daily. For the first six weeks or two months he should receive his groundwork, such as anatomy, embryology, physiology, pathology, bacteriology, physiological optics, and theory of refraction and accommodation. The rest of the time should be devoted to practical work, under direction. This should include the final working up of cases from start to finish, making, for himself, any bacteriologic or pathologic tests, outlining fields of vision, careful refraction, and in fact, any and everything necessary for a proper understanding of the case. Impress upon him the necessity of keeping careful records and of properly indexing and cross-indexing his cases, so that they may be utilized to advantage. Some of us have felt the need of this greatly, and have been most seriously handicapped. Personally I plead guilty to being one who was poorly drilled in this most important matter, and of being compelled to work under tremendous disadvantages for many years.

The subject is too large for anyone to attempt to cover in a single effort,—my main purpose in this paper being an endeavor to bring out discussions from the many capable men present.

Successful results cannot be hoped for without a good foundation. I know that some will argue that it is not necessary for one to be versed in higher mathematics or physiological optics to become a successful practicing ophthalmologist, and that it is practical knowledge we crave and not theory. I will admit that if one had but the choice of either, he must take the former. No one can deny, however, that a man well versed in both must be better able to cope with problems confronting him than one who has had only one or the other. Our aim should be to produce only the best. It is also most desirable that every effort should be bent toward not only preparing the postgraduate for successful practice, but to stimulate his ambition for research investigative work. Teach him how to train his power of observation in the laboratories as well as the clinics, in the matter of careful record notations. He should be taught in such a manner that he will think for himself and not have a fund of information dished out to him on a platter all prepared to be absorbed and digested which he is apt to promptly forget. This can be done even in the laboratory for physiological optics, as exemplified by the practical teaching in this branch conducted by Javal and Tscherning at the Sorbonne in Paris.

I remember my first experience on presenting myself to Professor Tscherning and telling him I wished to take his course. He started me in immediately by handing me a lens and asking me to find the focal distance. I placed a candle on the bench twenty feet away, measured the distance from the lens to the focused image, and handed it to him. He then placed the candle closer and said, "Find it now." The next problem was for me to find all of the images of the candle on the lens and tell which were real and which virtual. The same was done with plain, convex, and concave mirrors, and progressing from the simplest to the more complicated problems, always with the one idea of making the student think for himself, with the patient and learned and approachable Tscherning as the guiding spirit behind. If this can be done in a laboratory for physiological optics, similar methods can surely be adopted in any other kind of laboratory. In other words, we always come back to the one all-important and dominant idea in teaching—not to give a brilliant talk on a subject, but to train the student's power of observation and to make him think for himself. I think the method utilized by Dr. de Schweinitz of using lantern slides in his analysis of ocular diseases to be ideal, as it enables the student to both visualize with his sense of sight, as well as hearing, in acquiring theoretical knowledge, which he will later be more easily able to apply in a practical way.

There have been many opinions expressed as to the reason for the annual pilgrimage of American medical students to the clinics and universities abroad. I think the concensus of opinion agrees that it has been chiefly due to the high specialization, especially amongst the Germans, the subsidizing of whose universities by the Government permitted medical men to take up scientific investigation with remuneration almost commensurate with that which they would receive in practice. Thus, one could go to Axenfeld in Freiburg, Leber in Heidelberg, Wintersteiner and Salzman in Vienna, or Greef in Berlin for special courses in bacteriology or pathology—to Koenig in Berlin, or Tscherning in Paris, for special work in physiological optics—to Haab in Zürich or Hirschberg in Berlin for ophthalmoscopy or magnet instruction—to Fuchs in Vienna for general diagnosis and operative surgery.

In fact, one could select the special work which he felt most necessary, and then choose from several places, the course he found best fitted to his needs. Not alone that, but he could go to a large center, such as Berlin or Vienna, and find a special course in almost any branch of highly specialized subjects at almost any season of the year. What have we here in this country to offer as a substitute? There are some fairly good postgraduate courses given in several of our large cities. These, however, are usually given only once during the year and are general in character. There are very few exceptions.

I believe it would be feasible to increase the number of exceptions in all of our large university centers by proper educational propaganda. We already have authorities on physiological optics in Denver, pathology in Boston, plastic surgery in Detroit, and a few others we could mention. Can we not formulate a plan to utilize the large universities, such as Harvard, Hopkins, Washington University, and others, as well as the Wills Eye Hospital, Knapp Memorial, New York Eye and Ear, Massachusetts Eye and Ear, Illinois Charitable Eye and Ear hospitals, and others, in a concerted plan to establish highly specialized courses for the many desiring to equip themselves for practicing ophthalmology to the best advantage? I believe that an association could and should be formed, consisting of the heads of the eye departments of the leading universities and institutions especially adapted for the purpose. This applies not alone to ophthalmology, but to the allied branches and fundamentals so necessary to acquire, in order to have a broad and proper understanding of our subject. I remember going to Vienna a few years ago and taking a special course in general pathology, internal medicine, skin diseases, and nervous diseases. I could have had anything else I had wished at the time. It is up to the medical departments of our universities to start something in general, or ourselves in particular. As Dr. Arnold Knapp has said, the time is ripe for careful consideration and action in postgraduate teaching of ophthalmology. We should endeavor to stem the exodus of students abroad each year and make this country the Mecca for medical thought and knowledge. We have the material, facilities, and teachers. What is most needed is concerted action in formulating or drafting a definite scheme of procedure and carrying it out with the same firm decision and steadfast determination which finally gave victory to us and our Allies in the great war.

SUGGESTIONS FOR A POSTGRADUATE COURSE IN OPHTHALMOLOGY.[1]

By Dr. ALEXANDER DUANE, New York.

CONTACT with ophthalmologists during the last quarter of a century has convinced me that not only is there imperative need of better and more thorough teaching of ophthalmology in this country, but, further, that there is a constantly increasing demand for it among the men who come to us for instruction. Our schools have been increased, our facilities have been enlarged, but, nevertheless, the supply has not kept up with the demand. The men who come to us for instruction demand more intensive work, more complete work, and, particularly, work that will occupy their whole time.

Hitherto this has scarcely been attainable except by private enterprise.

The ideal that we have to set before us to fulfill the wants so frequently expressed, is an institution which shall give the student full-time instruction, so graded and so coördinated, that he shall receive in four or five months' time, the instruction that is now spread over a year, and shall, moreover, get that instruction not in a haphazard way but in such fashion that nothing is omitted and nothing duplicated nor taken out of turn.

With regard to such an institution and the course it could offer, the following seem to me points worthy of consideration.

First, careful and thorough instruction in the fundamentals and in the theory of ophthalmological work must precede practical study. This principle, fully recognized in undergraduate teaching, is of even more importance in postgraduate work. During the years in which I have been teaching ophthalmology I have had largely to do with men of rather mature age who had already been engaged in the practice of the specialty for some time. Such men have not the mental pliability nor the readiness to grasp abstract reasoning that the undergraduate has. The practical, they can easily take in; they are keen for clinical teaching and operative work; other things, less easy to them, they are apt to neglect unless these are insisted on. It is all the more important then that their theoretical deficiencies, which they find it rather hard to fill up, should receive particular attention. In fact, if there is one thing more than another that my teaching work has impressed on me, it is the necessity in the case of postgraduates of thorough drill in the theory of each branch of ophthalmology, before taking up its practical application. Thus a student should not begin to examine patients for glasses until he has had a thorough drill in the optical properties of lenses and of the other appliances used in refraction work and also in the optical properties of the normal and ametropic eye; nor should he begin to make examinations with the ophthalmoscope until he has had sufficient optical training to understand the principles underlying the working of the instrument in all its applications and also sufficient training in the anatomy and pathology of the eye to comprehend the nature of the appearances and the lesions he encounters. Again he should not undertake to test patients for disturbances of motility until he has been carefully drilled in the anatomy and physiology of the muscles and nerves, understands the various types of eye-movements, how they are produced, and how measured, and has studied the theory of their derangements. So, too, operative work is not taken up until by didactic teaching and laboratory work, the student has become well informed as to the anatomy and pathology of the eye.

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[1] Presented in abstract at the Section on Ophthalmology of the New York Academy of Medicine, October 20, 1919.

In its entirety, this principle cannot be applied to the study of external diseases, because, in a short course, the student to cover the extensive ground of clinical work must see patients from the start. Here a middle course is advisable, *i.e.* for the first half of his period of instruction and while he is pursuing the other elementary courses, the student should see in the main only selected cases, and his observation of them should be fortified by didactic instruction and by quizzes. On this plan, during the first two weeks when he is learning the anatomy and histology of the exterior parts of the eye, he takes up mainly diseases of the conjunctiva and lids. On these his instructors give him short practical lectures before demonstrating the patients. On the contents of these lectures he is quizzed and of the cases themselves he is expected to render case reports, which are criticized by the instructors. Through the succeeding weeks this program is carried on, the student studying successively diseases of the cornea, diseases of the uveal tract, glaucoma, and affections of the lens. At the end of this time (say, in eight to ten weeks) he is prepared to take up the study of miscellaneous cases, for which he is the better fitted because he has by this time had a good drill in laboratory work, in ophthalmoscopy, and in motility.

One essential point in the fundamental training that needs emphasis at the start is drill in what may be called methodology and also in the general principles of ætiology and therapeusis. Hence during the first two weeks the student should be schooled in the symptomatology of the eye, in the art of history taking, and in the practice of making examinations in external cases according to a systematic thorough routine. This is a point that I used to insist on in my classes, directing the students invariably to pursue a regular routine so that no detail should be omitted in determining the facts. In office work we cannot always do this with the thoroughness that we exact of our students. Sometimes, indeed, we fail because we are not thus thorough. But, however this may be, there is no question but that the student should be taught to make an examination that is absolutely systematic, thorough, and complete, so that, whatever else may be his deficiencies, he shall not miss any diagnostic point from failure to look for it, nor miss any symptom from failure to ask about it.

In the matter of general ætiology, the student should be taught at the outset the relationship of eye disease to systemic disorders and to diseases of other organs; and early, too, he should be taught the general principles of ocular therapeusis.

My second point to which I should like to call particular attention is that between this thorough drill in the elementary theory and the unrestricted practical work, an intermediate step should be taken. In a paper just presented before the Academy of Ophthalmology and Oto-Laryngology Dr. Clarence Loeb has very rightly pointed out that our textbooks fail to assemble the facts in the form most helpful to the student. They give, that is, a description of a disease, its causation, pathology, and symptoms, but ignore the fact that what the tyro meets with is symptoms from which he has to unravel the cause. This defect was recognized in my student days and was remedied in certain of the quiz courses and occasionally in certain special textbooks. In these, groups of symptoms were assembled and analyzed and the various conditions that might cause them were given and differentiated. For instance, the various conditions likely to cause abdominal pain were tabulated and contrasted. Or, disease pictures were given and hypothetical cases, and from these the diagnosis was elicited. This, which we may call the preclinical course, because it paves the way for the examination of actual cases, is one of the most stimulating and helpful methods of teaching.

I may illustrate what I mean by showing what I used to do in ophthalmoscopic teaching. After drilling the men in the theory of the ophthalmoscope, and in showing the student what particulars he was to observe in the course of a systematic examination as regards the media, the disk, the retinal vessels, and the color and transparency of the retina and choroid, I would assemble for them, first, all the conditions that might cause a real or simulated change in the shape of the disk; next all the conditions that would make the disk hazy or indistinct; then, all the conditions making the disk paler or redder than normal, the conditions causing narrowing of the arteries or their distention, the conditions causing swelling and excavation of the disk, the conditions causing whitish areas, spots, or masses in the fundus, the conditions causing black spots, etc. This sort of drill, supplementing and correlating the study simultaneously made of the symptomatology of the diseases themselves, made the student ready to appreciate and keen to differentiate the various appearances that he was to see when he began to apply the ophthalmoscope.

In like manner, a whole series of questions can be framed which will call the student's attention to the possible causes underlying any given symptom presented. Such questions are:

What conditions may cause contraction of the visual field and how differentiate them?

What conditions may cause a central scotoma?

What conditions are associated prominently with pain in the eye, and how tell them apart?

These and other like questions may be supplemented by supposititious histories, illustrating more or less typically cases of toxic amblyopia, syphilitic ocular paralysis, retinal detachment due to tumor, etc.

Students derive most advantage from such group questions and hypothetical histories, if these are given to them as problems for them to solve. This is a stimulating practice because it exercises their memory and reason and makes them learn at first hand how to differentiate like but not identical conditions. The student works out his problem as best he can, and his solution is afterward criticized by his instructor in the presence of the members of the class, each of whom adds his own suggestions. In this way each anticipates the clinical work to come later.

The third point that I should like to emphasize is the supreme importance of individual instruction. This means teaching small classes, each consisting as far as possible of men of approximately the same ability and training. The old West Point method by which students were divided into sections, according to their ranking, section A comprising the top men, section B the next, and so on, offers an example worth imitating, for in handling a homogeneous section there is much less time lost, and the better men are not held back by the less able.

In handling such sections I have found the best method that of alternate lecture and quiz, with frequent short snappy reviews. The teacher working in this way soon finds whether the men in the class are following him and what their individual difficulties are, and shapes his discourses accordingly. In the best sense of the word, he uses the argumentum ad hominem. By this personal contact and by the interchange of ideas involved in the method of question and answer, he is able to stimulate interest and excite enthusiasm better than in any other way that I know of.

All the preceding involves the thought of a definite sequence in the work. Unless such sequence is carefully provided for, there will be more or less duplication of work and some ground will be covered before the student is ready for it.

Following out these ideas I have framed the following outline of a short intensive ophthalmological course for postgraduates. This course is designed to cover four months (seventeen weeks). When possible the work is intended to be continuous during the year, and this may be effected either by having three consecutive or five overlapping courses. The latter plan (Plan A subjoined) is the better, if sufficient instructors are available. In this regard, as will be pointed out presently, a good deal of assistance is supposed to be derived from advanced students.

The students themselves while completing the course in seventeen weeks, should be encouraged to stay for a full half year, utilizing the extra nine weeks for advanced clinical and operative work, and for special study, varied according to their taste and capacity (*e. g.*, taking advanced work in physiological optics or perfecting themselves in laboratory technique). Such students should be particularly available as clinical assistants and as teachers and quiz masters.

On the other hand, in the course outlined, a man who could not afford to spend even seventeen weeks, could in three months (thirteen weeks) gain at least a good preliminary training in laboratory work, physiological optics, refraction and motility, and make a fair beginning in the art of examining and handling external cases and in the technique of operations. This work he could advantageously supplement later by reëntering and taking another three-months course, beginning where he left off.

For all classes of students the first twelve weeks of the course would be spent almost entirely in elementary work. During this time predominant stress would, at first, be laid on theory and methods, while later more and more time would be devoted to the practical application of the theory. In the last five weeks the work would be exclusively practical and advanced.

Furthermore by the free use of quiz and conference, by the preparation and criticism of case reports, and by the individual character of the teaching made possible through distribution of the class in small, graded sections, the student would not simply be taught but would be educated in the true sense of the term, *i.e.*, would have his faculties of observation, comparison, and judgment gradually trained and brought out. To take one example of what I mean, the act of "viewing operations" would signify not simply looking on, but having the purpose and significance of what the operator was doing explained, and would imply also the taking of careful notes to be afterward criticized by the instructor.

During the period of advanced training (after the first ten weeks), the students, especially those entering for a half-year's work, would act as assistants in the clinic or laboratory and help in the teaching, *e.g.*, by quizzing the students of the succeeding section, by drilling them in refraction or in ophthalmoscopy, and in other ways. This would not only help to make good any dearth of instructors, but would be a great help to the men undertaking the work, for there is no question but that the very art of teaching a subject, recently acquired, confirms one's knowledge and clarifies one's ideas.

CONSPECTUS OF COURSE.

1. *Anatomy and Physiology of Eye.*—Lectures, demonstrations, and quiz. 1st and 2d weeks, gross anatomy and physiology of lids, lacrimal apparatus, conjunctiva and cornea; 3d and 4th weeks, uveal tract, lens, orbit, and sinuses.

   3 hours a week.

2. *Laboratory.*—1st and 2d weeks, histology of eye; 3d and 4th weeks, histology and embryology; 5th to 7th week, bacteriology; 8th to 12th week, pathology including X-ray diagnosis. Laboratory drill in sections, advanced students acting as assistants.

   6 hours a week.

3. *Optics and Theory of Refraction.*—(a) 1st to 4th week, physical optics; 5th to 7th week, physiological optics; 8th week, theory of refraction. Lectures, demonstrations, and quiz in sections.

   3 hours a week.

(b) Practice of refraction.—9th to 14th week. Advanced students act as assistants.

6 hours a week.

4. *Ophthalmoscopy.*—5th and 6th weeks, theory and methods; 7th to 12th weeks, practice. Advanced students assist in the teaching.

3 hours a week.

5. *Neurology of Eye.*—1st and 2d weeks, anatomy and physiology of retina, optic nerve, and central connections; 3d and 4th weeks, methods of neurological examinations; testing of pupil; 5th to 8th week, examination of cases.

3 hours a week.

6. *Perimetry and Color Testing* (*with testing of Light Sense*).—3d to 7th week.

2 hours a week; in 7th week, 4 hours.

7. *Motility.*—1st and 2d weeks, anatomy and physiology of muscles and oculo-motor nerve centers; 3d and 4th weeks, normal eye movements, monocular and binocular; 5th and 6th weeks, theory of derangements of motility, methods of examination; 7th to 10th week, examination of cases.

3 hours a week.

8. *Methodology.*—1st and 2d weeks, history taking, symptomatology, method and routine of examining external cases; method of making case reports.

3 hours a week.

9. *Ætiology and Therapeusis.*—1st to 4th week, ætiology of eye diseases, relation of diseases of eye to systemic affections or diseases of other organs; 5th and 6th weeks, therapeusis of eye diseases.

2 hours a week.

10. *Study of Symptom Groups and Hypothetical Cases.*—Problems in these matters set to students; criticism of solutions—3d to 7th week.

2 hours a week.

11. *Clinical Work (Elementary).*—1st and 2d weeks, cases mainly of diseases of conjunctiva and lids, and lacrimal apparatus; 3d and 4th weeks, diseases of cornea; 5th and 6th weeks, diseases of uveal tract; 7th week, glaucoma with instruction in tonometry; 8th week, diseases of lens and vitreous; 9th and 10th weeks, special cases, review, and examinations. Advanced students assist especially in demonstration of cases and in quiz.

6 hours a week, lectures and demonstrations.
3 " " " quiz on lectures and cases seen.
2 " " " discussion and criticism of case reports presented by students.

12. *Clinical Work (Advanced).*—11th to 17th week,[1] miscellaneous cases.
    (a) Examination of cases, 10 hours (in 15th to 17th week, 12 hours) a week.
    (b) Case reports, 2 hours a week (including reports on operative cases).
    (c) Ward visits (13th to 17th week), 6 hours a week (this would also include operative cases).

13. *Operations (Elementary Work).*—8th week, principles of operating and antisepsis; 9th to 14th week, operations on cadaver and pigs' eyes.

5 hours a week.

14. *Viewing Operations.*—Demonstration of operative methods; quiz on operations seen; discussion of case reports of operations and cases operated on—8th to 17th week.

3 hours a week (8th to 12th week); 6 hours a week, (13th to 17th week).

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[1] For long-time students, 11th to 26th week.

15. *Advanced Operative Work.*—15th to 17th week.[1] Assisting at operations; dressing of cases; operations on living; ward visits and case reports (see under Clinical Work 12*b* and 12*c*).

5 hours a week.

16 *Teaching.*—11th to 17th week,[2] teaching and quizzing especially in refraction, ophthalmoscopy, and external diseases; assisting in laboratory and clinic.

3 hours (in 15th to 17th week, 5 hours) a week.

17. *Special and Advanced Work.*—Special work in laboratory, physiological optics, clinical work, or operating; research work—18th to 26th week in case of long-time students.

Hours by arrangement.

The courses of seventeen weeks each may be arranged according to two plans:

PLAN A

Plan A comprises five overlapping courses a year, each new course beginning ten weeks after the preceding.

(Allows 4 weeks' vacation—one week at Christmas, 3 weeks in September or August.)

The successive classes are denoted by the letters A, B, C, etc., A^1, B^1, etc., denote the short-time students who stay for 17 weeks only; A^2, B^2, etc., those staying for 26 weeks. The figures at the tops of the columns refer to the subjects in the preceding Conspectus of Studies. The 26 weeks here shown cover two periods and a half. At the beginning of the first period, class C is just starting, class B has completed most of its elementary studies and is starting on advanced work, and the long-time members of class A (A^2), are entering on their last 6 weeks, which are devoted to advanced operative and other special work, research work, or to volunteer service as instructors or assistants.

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[1] For long-time students 15th and 26th week.

[2] For long-time students, 11th to 26th week.

Weeks	ELEMENTARY WORK												ADVANCED WORK					
	1	2	3a	3b	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Course I begins																	
1	C^1 C^2	B^1 B^2 C^1 C^2	C^1 C^2	B^1 B^2	B^1 B^2	C^1 C^2		C^1 C^2	C^1 C^2	C^1 C^2		C^1 C^2	B^1 B^2	B^1 B^2	B^1 B^2	A^2	B^1 B^2	A^2
2	" "	" " " "	" "	" "	" "	" "		" "	" "	" "		" "	" "	" "	" "	"	" "	"
3	" "	C^1 C^2	" "	" "		" "	C^1 C^2	" "		" "	C^1 C^2	" "	" "	" "	" "	"	" "	"
4	" "	" "	" "	" "		" "	" "	" "		" "	" "	" "	" "	" "	" "	"	" "	"
5		" "	" "		C^1 C^2	" "	" "	" "		" "	" "	" "	" "		" "	B^1 B^2	" "	"
6		" "	" "		" "	" "	" "	" "			" "	" "	" "		" "	" "	" "	"
7		" "	" "		" "	" "	" "	" "			" "	" "	" "		" "	" "	" "	
8		" "	" "		" "	" "		" "				" "	B^2	C^1 C^2	C^1 C^2	B^2	B^2	
9		" "		C^1 C^2	" "			" "				" "	"	" "	" "	"	"	
10		" "		" "	" "			" "				" "	"	" "	" "	"	"	
	Course II begins																	
11	D^1 D^2	C^1 C^2 D^1 D^2	D^1 D^2	" "	" "	D^1 D^2		D^1 D^2	D^1 D^2	D^1 D^2		D^1 D^2	C^1 C^2	" "	" "	"	C^1 C^2	B^2
12	" "	" " " "	" "	" "	" "	" "		" "	" "	" "		" "	" "	" "	" "	"	" "	"
13	" "	D^1 D^2	" "	" "		" "	D^1 D^2	" "		" "	D^1 D^2	" "	" "	" "	" "	"	" "	"
14	" "	" "	" "	" "		" "	" "	" "		" "	" "	" "	" "	" "	" "	"	" "	"
15		" "	" "		D^1 D^2	" "	" "	" "		" "	" "	" "	" "		" "	C^1 C^2	" "	"
16		" "	" "		" "	" "	" "	" "			" "	" "	" "		" "	" "	" "	"
17		" "	" "		" "	" "	" "	" "			" "	" "	" "		" "	" "	" "	
	Course I ends																	
18		" "		D^1 D^2	" "	" "		" "		" "		" "	C^2	D^1 D^2	D^1 D^2	C^2	C^2	
19		" "		" "	" "			" "				" "	"	" "	" "	"	"	
20		" "		" "	" "			" "				" "	"	" "	" "	"	"	
	Course III begins																	
21	E^1 E^2	D^1 D^2 E^1 E^2	E^1 E^2	" "	" "	E^1 E^2		E^1 E^2	E^1 E^2	E^1 E^2		E^1 E^2	D^1 D^2	" "	" "	"	D^1 D^2	C^2
22	" "	" " " "	" "	" "	" "	" "		" "	" "	" "		" "	" "	" "	" "	"	" "	"
23	" "	E^1 E^2	" "	" "		" "	E^1 E^2	" "		" "	E^1 E^2	" "	" "	" "	" "	"	" "	"
24	" "	" "	" "	" "		" "	" "	" "		" "	" "	" "	" "	" "	" "	"	" "	"
25		" "	" "		E^1 E^2	" "	" "	" "		" "	" "	" "	" "		" "	D^1 D^2	" "	"
26		" "	" "		" "	" "	" "	" "			" "	" "	" "		" "	" "	" "	"

PLAN B

3 Terms of 17 weeks each. Consecutive.

Classes C^1 (short-time) and C^2 (long-time) students just beginning. Long-time students of previous section (B^2) just ending.

At 18th week new section (D^1 and D^2) begins.

I am well aware that a four months' course is not sufficient to give a man full training in ophthalmology. For example, the time here allotted for physiological optics, for laboratory practice and for operative work should properly be extended by several weeks, in each instance. Nevertheless, a man who pursues the course here outlined could gain a thorough training in the fundamentals of each subject, enabling him to continue further study with advantage as opportunity offered, and would be able to enter on ophthalmological practice with a well justified confidence that he could handle most cases with intelligent knowledge and reasonable skill.

For men who have already had some training and experience in eye work, the course outlined and particularly the half-year (long-time) course would be specially beneficial. It would extend and complete their knowledge and because of the drill in the fundamentals, would put it on a sound basis. After completing it, they will have learned to handle cases of all types methodically and according to an intelligent plan. Ordinary external diseases, errors of refraction and motor anomalies—the three conditions that will constitute the vast bulk of their practice—they should be able to manage without difficulty. And, what is perhaps equally important, they will have learned to recognize their limitations, and when they meet with a case that they cannot diagnosticate or handle, they will appreciate the fact and refer it to one more skillful. Lastly, they will be stimulated by the knowledge that they have gained and the appreciation of their deficiencies to further study and practice in order to render their education indeed complete.

	ELEMENTARY WORK												ADVANCED WORK					
	1	2	3a	3b	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Week	*Course I begins*																	
1	C^1 C^2	C^1 C^2	C^1 C^2			C^1 C^2		C^1 C^2	C^1 C^2	C^1 C^2		C^1 C^2	B^2		B^2	B^2	B^2	B^2
2	" "	" "	" "			" "		" "	" "	" "		" "	"		"	"	"	"
3	" "	" "	" "			" "	C^1 C^2	" "		" "	C^1 C^2	" "	"		"	"	"	"
4	" "	" "	" "			" "	" "	" "		" "	" "	" "	"		"	"	"	"
5		" "	" "		C^1 C^2	" "	" "	" "		" "	" "	" "	"		"	"	"	"
6		" "	" "		" "	" "	" "	" "			" "	" "	"		"	"	"	"
7		" "	" "		" "	" "	" "	" "			" "	" "	"		"	"	"	"
8		" "	" "		" "	" "		" "				" "	"	C^1 C^2	C^1 C^2	"	"	"
9		" "		C^1 C^2	" "			" "				" "	"	" "	" "	"	"	"
10		" "		" "	" "			" "				" "		" "	" "			
11		" "		" "	" "								C^1 C^2	" "	" "		C^1 C^2	
12		" "		" "	" "								" "	" "	" "		" "	
13				" "									" "	" "	" "		" "	
14				" "									" "	" "	" "		" "	
15													" "		" "	C^1 C^2	" "	
16													" "		" "	" "	" "	
17													" "		" "	" "	" "	
	Course I ends; Course II begins																	
18	D^1 D^2	D^1 D^2	D^1 D^2			D^1 D^2		D^1 D^2	D^1 D^2	D^1 D^2		D^1 D^2	C^2		C^2	C^2	C^2	C^2
19	" "	" "	" "			" "		" "	" "	" "		" "	"		"	"	"	"
20	" "	" "	" "			" "	D^1 D^2	" "		" "	D^1 D^2	" "	"		"	"	"	"
21	" "	" "	" "			" "	" "	" "		" "	" "	" "	"		"	"	"	"
22		" "	" "		D^1 D^2	" "	" "	" "		" "	" "	" "	"		"	"	"	"
23		" "	" "		" "	" "	" "	" "			" "	" "	"		"	"	"	"
24		" "	" "		" "	" "	" "	" "			" "	" "	"		"	"	"	"
25		" "		D^1 D^2	" "	" "		" "				" "	"	D^1 D^2	D^1 D^2	"	"	"
26		" "		" "	" "			" "				" "	"	" "	" "	"	"	"

EPITHELIAL INLAY AND OUTLAY IN LID REPAIR ILLUSTRATED.[1]

By Colonel S. HANFORD McKEE, C.M.G., C.A.M.C.

Formerly, Officer Commanding, Westcliffe Canadian Eye & Ear Hospital.

(With nine illustrations on Text-Plates I.–III.)

EYE injuries in previous wars have formed only a small percentage of all wounds. While the proportion in the late war may not be much higher, Armageddon with its terrible face injuries has brought this subject very prominently before us. It has given us the opportunity for wonderful development in plastic surgery of the face and has forced upon us the necessity for studying the restoration of the orbit and eyelids, and repair of the conjunctival sac, so that an artificial eye may be worn.

It is not my purpose in this paper to cover the subject of plastic surgery of the eyelids in so far as pedunculated skin flap and transplantation of cartilage are concerned, but to take up for a few minutes what I expect most of the members are now well acquainted with, namely epidermic inlay, in its relation to the enlargement of the conjunctival sac, and secondly, epidermic outlay and its use in lid repair.

In the *Annals of Surgery* for March, 1917, Essen has given us his "Studies in Plastic Surgery of the Face" and has described there, in detail, his method for enlargement of the conjunctival sac.

The difficulty met with in enlarging this cul-de-sac, or rather in retaining an enlargement made, will be readily admitted by

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[1] Read at the American Academy of Ophthalmology and Oto-Laryngology, October 17, 1919.

ILLUSTRATING DR. MCKEE'S ARTICLE ON "EPITHELIAL INLAY AND OUTLAY IN LID REPAIR ILLUSTRATED."

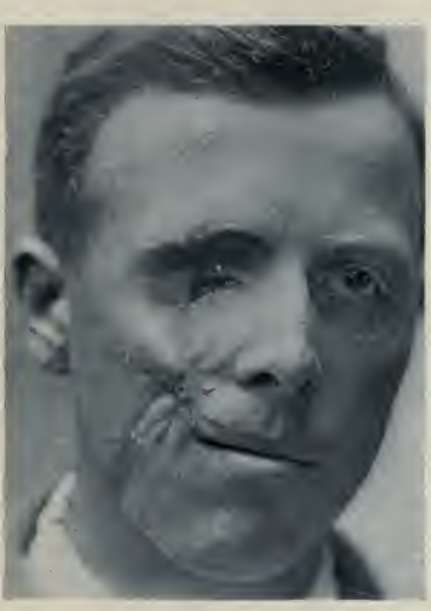

FIG. 1. Original condition.

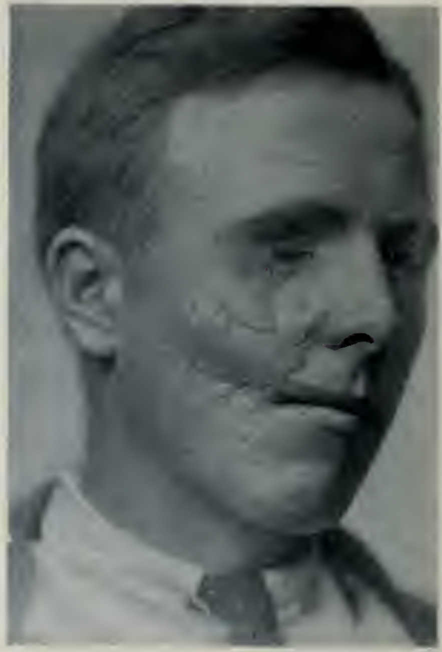

FIG. 2. Excision of scar and repair.

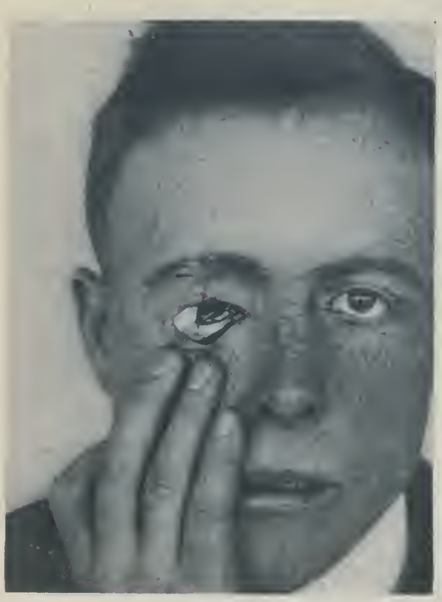

FIG. 3. Note large epidermic inlay and how socket has been enlarged from Fig. 2.

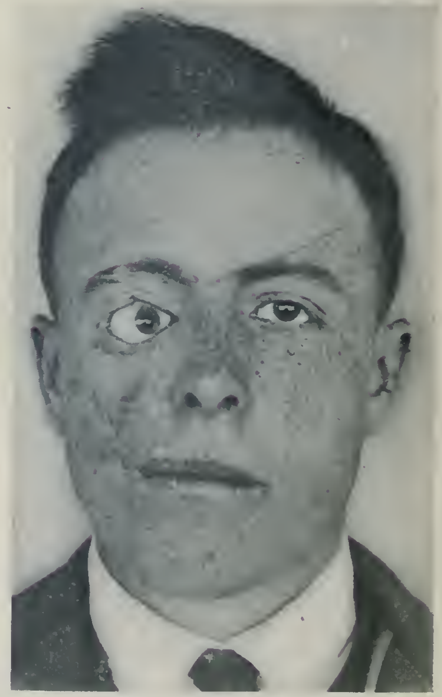

FIG. 4. Large eye temporarily used to show extent of new formed cavity.

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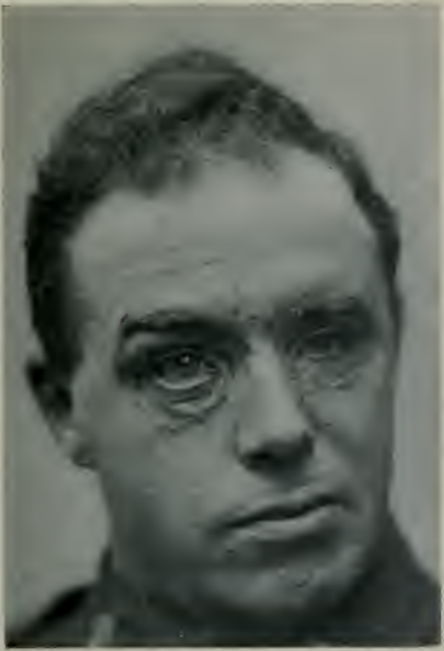

FIG. 5. Epidermic outlay.
R. lower lid.

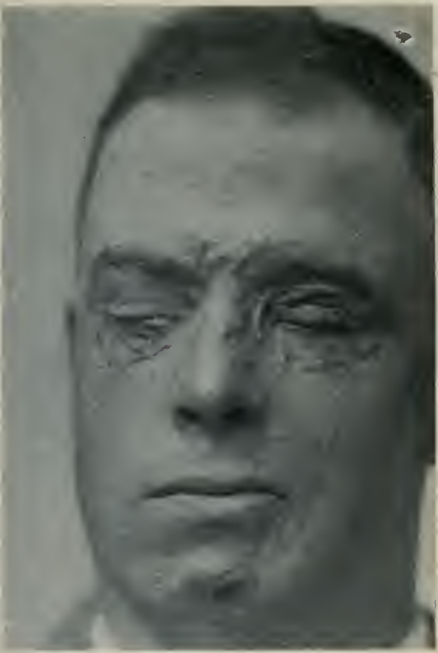

FIG. 6. Epidermic outlay.
L. upper lid.

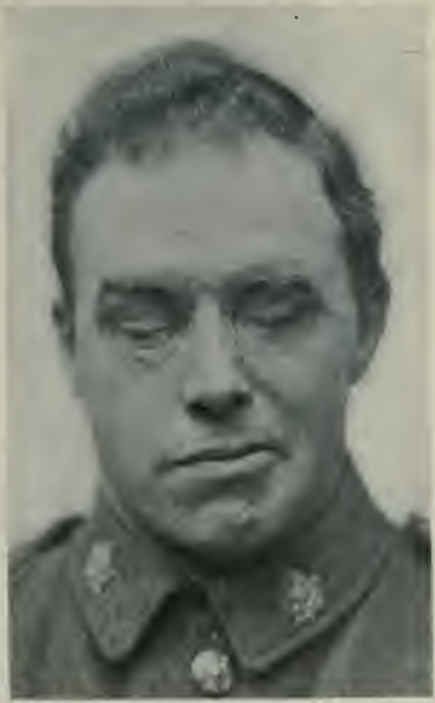

FIG. 7. Showing both eyes closed,
ectropion repaired.

all. This difficulty has now been done away with and Esser, Gillies, Waldron, Risdon, and others have given us a method as satisfactory in results as it is simple in procedure. Esser enlarged the conjunctival sac by means of a buried skin graft. An incision was made through the eyelid skin parallel to the palpebral fissure and extended laterally according to the extent of the conjunctival deficiency. The tissues were then undercut as close to the conjunctival sac as possible without perforating into the same, and an impression of the cavity thus formed taken with dental compound sterilized by boiling. The mold was then pared until the margins of the incision could be brought together without undue tension.

A thin Thiersch graft was then taken from the inner surface of the upper arm and wrapped around the mold. The whole was then inserted into the cavity and the margins of the incision carefully sutured over it. In two weeks' time an incision was made through the conjunctiva overlying the mold, which was then removed, and the epithelialized area thus formed maintained by the immediate insertion of a temporary shell until an artificial eye could be fitted.

Waldron very materially modified and improved that technique by making the primary incision *in the conjunctival sac* instead of through the eyelid skin. The tissues were then undercut until a cavity somewhat larger than that desired was obtained. The dental compound was then made, covered by skin graft, buried, and held in place by suturing the cut margins of the conjunctiva.

Where it is found difficult to make an incision close to the tarsus and to do the necessary undercutting, an incision outwards and slightly downwards for 1*cm* from the external canthus is made. This permits easier eversion of the lid and renders the operative field more accessible.

Waldron claims for his modification: (1) Unnecessary scarring of the eyelids is prevented and the normal elasticity of the skin is not impaired. As it is not uncommon to have an accumulation of serum develop around the buried graft, sutures may give way, and slight infection may take place without impairing the success of the graft. These minor complications, however, in the case of inlays buried through an incision in the eyelid skin may lead to granulation and scarring, and in rare instances epithelialized fistulæ have developed, necessitating operative excision and closure. (2) The exact position of the new fornix may be better outlined by an initial incision through the conjunctiva than by the undercutting to a point just beneath the surface of the conjunctiva. In our experience, the fornix may be made closer to the tarsal plate by incising through the conjunctiva. (3) The depth and direction of the cavity can be readily determined according to the necessity of the individual case.

After cutting the conjunctiva and removing the compound in a few cases, I felt the suturing in of the compound so that the conjunctiva had to be cut to release it was a mistake and a weak spot in the technique, and I soon began leaving a space at the top so that while the compound and graft were still held properly in place, the former could be removed without any cutting. Risdon has improved on this idea and keeps his graft over compound in place by the pressure of the lids alone. So, to enlarge the upper or lower conjunctival cul-de-sac, an incision is made above or below to the extent thought needed. Dental compound is molded and fitted and a Thiersch graft is then buried and held in place for one week or ten days by the upper and lower lids alone or drawn together by a suture. At the end of ten days the lids are separated, the compound removed, and an artificial eye inserted immediately.

Each case must be studied on its merits and where one variation may suit one case, it probably will not do at all in the next. Naturally the size, shape, and position of the mold vary considerably. Where there is a general contraction of the socket, I, at one period, thought putting the graft in the *mid-line* a good idea. This I now think a mistake and feel sure the enlargement should be made either below or above. This will give a much better *cul-de-sac* for a glass eye than the general enlargement from a centrally inserted inlay.

Pte. D. Admitted to Hospital with right eye enucleated, gonorrhœal ophthalmia—socket very shallow. An incision was made along whole floor of cavity and an inlay over compound inserted. Three days later the compound had suppurated out. The graft took completely.

Pte. McI. Admitted to Hospital G. S. W., left eye enucleated, the left lid so adherent, there was no cul-de-sac below.

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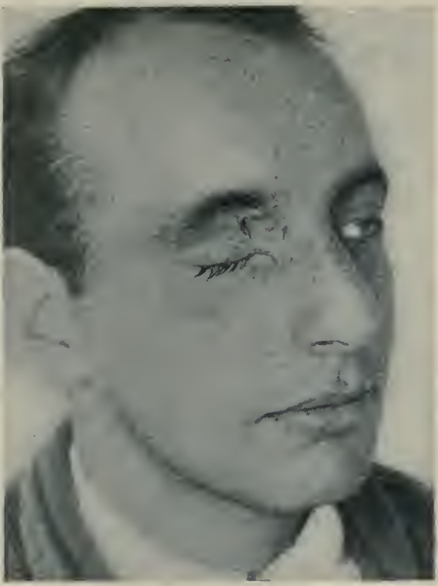

FIG. 8. R. Large epidermic outlay above to lower right inner canthus.

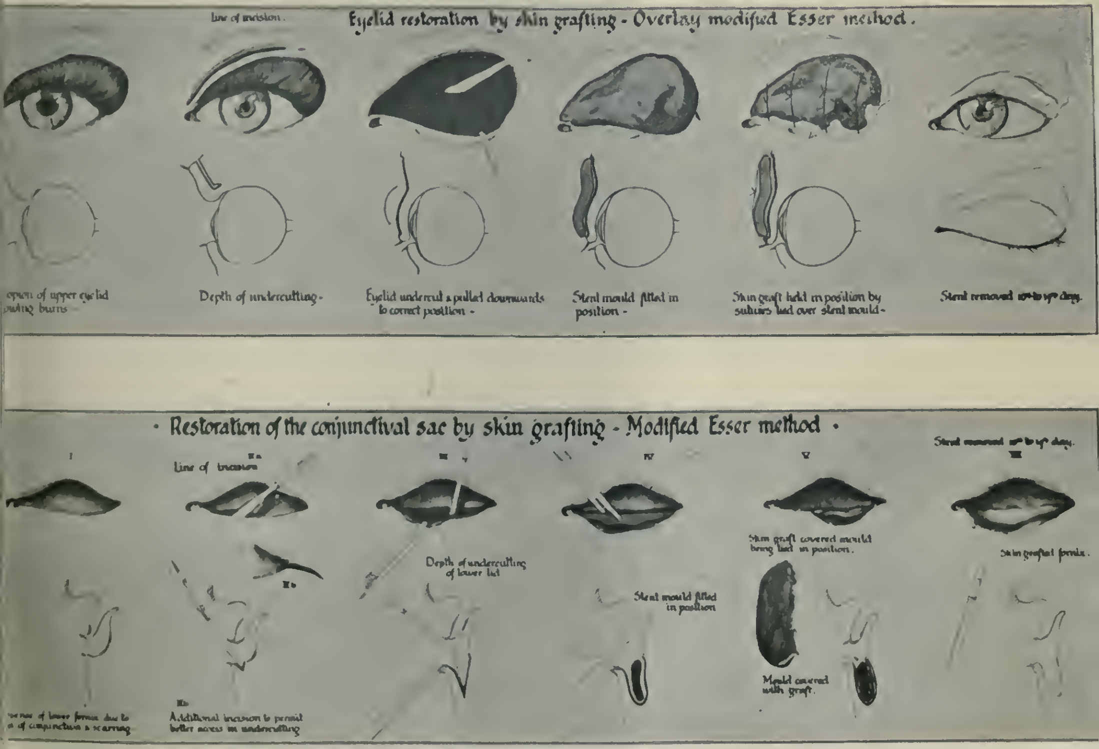
Line of incision.
Eyelid restoration by skin grafting - Overlay modified Esser method.
of upper eyelid
burns -
Depth of undercutting -
Eyelid undercut & pulled downwards to correct position -
Stent mould fitted in position -
Skin graft held in position by sutures tied over stent mould -
Stent removed [illegible] day.
· Restoration of the conjunctival sac by skin grafting - Modified Esser method ·
I
IIa
Line of incision
III
IV
V
VI
Stent removed [illegible] day.
IIb
Depth of undercutting of lower lid
Stent mould fitted in position
Skin graft covered mould being tied in position.
Skin grafted fornix.
Mould covered with graft.
of lower fornix due to
of conjunctiva & scarring
IIb
Additional incision to permit better access in undercutting

FIG. 9. Drawings made for Major C. W. Waldron, C.A.M.C., to demonstrate different steps in epidermic
erlay and inlay.

Under ether a large inlay was put in below. Five days later the stitches broke away and the compound suppurated out. In spite of this the graft remained and became a most satisfactory result. These two cases are cited to emphasize a very important point, that suppuration will not destroy your result.

Gillies, of Queen's Hospital, has given us two modifications of the Esser process. In the first, called by him epithelial outlay, the mold covered with graft is buried in the subcutaneous tissues through an incision in the skin and is removed though the same incision. The cavity opened is covered with skin. It is really the converse of the inlay. In cases of severe ectropion from wounds or burns this method will be found most excellent. The eyelid skin may be increased to the extent of the grafted area. In burn cases the skin needs to be increased particularly in the vertical direction. The line of the incision and amount of undercutting varies of course with individual cases according to the degree of injury to be repaired. The incision is widened and deepened according to the amount of new tissue desired. Due care is taken to avoid injuring the levator palpebræ superioris.

After the dental compound is in position, the ectropion is, of course, more marked than before.

The second method of Gillies is termed epithelial overlay and is of great service where there has been extensive loss of tissue. Here extensive undercutting may be necessary, before the remains of the eyelid can be brought to its normal position, and the covering in of a graft-covered mold is impossible. In that case the remains of the eyelid may be sewn in a favorable position, the scars excised, and an impression taken of the entire raw area. A Thiersch graft is then applied to the raw area and held firmly in place by means of the compound impression. This method will often do away with the necessity for pedunculated flaps.

I hope my remarks have been sufficient to give you some idea of what can be done in the repair of lids by epidermic inlay and outlay.

It is essential that the cavity be made much larger than thought necessary. It will undoubtedly shrink some. Suppuration will not destroy your result. After the compound is removed, put in an artificial eye as soon as possible This often has a beneficial effect on the hypersecretion sometimes present.

These methods are not a panacea, though they give results vastly superior to any previous ones, and offer much to ophthalmic surgeons. The results obtained in extensive ectropion following burns by the epidermic outlay technique of Gillies, are most satisfactory. Equally so are the results obtained by the epidermic inlay method of Waldron, in injured lids and in shallow and distorted conjunctival sacs. The development in military ophthalmology along these lines has been extensive indeed.

WAR INJURIES OF THE EYELIDS.

PLASTIC OPERATIONS FOR A FEW TYPES. CASE REPORTS WITH PHOTOGRAPHS AND DRAWINGS.

By CAPTAIN JOHN M. WHEELER, M. C., U. S. A., FORT MCHENRY, MD.

(*With thirteen illustrations on Text-Plates IV and V.*)

AT Fort McHenry we have had a large and active service in plastic surgery about the eyes. Much of this has had to do with the lids. We have had large enough series of cases of different types so that we could study methods, and it is my desire to present a few suggestions in regard to the surgical handling of some of the types of lid injury.

1. *Notch of the Eyelid Associated with Laceration of the Tarsus.*—Illustrative of this type of injury, let me cite the history of a case.

McG. received a gunshot wound. Enucleation of the right eye had been performed in France. There was a marked disfigurement of the upper lid in the form of a notch. The tarsus was torn through completely, and imperfect union with scar tissue formation had taken place. A cicatricial band extended upward from the tarsal laceration in the lid substance, and a second band could be felt beneath the skin to the nasal side of the notch and independent of it, attached above to the orbital rim.

Fig. 1 illustrates the outward appearance of the deformity.

Operation.—The little mass of scar formation in the tarsus was excised, and the tarsal flaps were trimmed to give accurate apposition. Care was taken to excise fully as much tarsus at the upper margin as at the lower margin in each flap of tarsus. This is important, and even a slight overcorrection of the notch can be encouraged, at the surgeon's discretion, by diverging the tarsal incisions from the lid margin, so as to make the tarsal flaps slightly shorter above than below. The skin and orbicularis were cut so as to make a flap as shown in Fig. 2.

The little tongue of skin was trimmed enough for adjustment, and above a small triangular piece of skin was removed, to save puckering. The conjunctiva and tarsal flaps were sutured as illustrated in Fig. 3. A mattress suture was carried through the flaps, as shown in Fig. 2, and tied after passing through a small rubber plate. Sutures were introduced to give good apposition of the skin flaps (Fig. 4). Dissection of the independent band of scar tissue was made through a separate skin incision (Fig. 4). The lids were then sewed together, so that the lower lid margin would act as a splint for the upper. Care was taken not to tie any of the sutures too tight and so cause sloughing. A rubber tissue dressing was applied. The sutures were all removed in four days.

An important point is that tarsal incisions and skin incisions should never be in the same position, but should be made in such a way that there is overlapping. Thus, what is known in carpentry as *halving* is accomplished, and union is assured, even if there is a little sloughing of the skin. Furthermore, recurrence of the notch formation is prevented.

In handling notch cases different short-cut procedures have been tried, but the "halving" method has been the only satisfactory one in my hands.

If necessary, to prevent tension on the wound, especially if the eyeball has not been removed, a canthotomy should be performed, and the branch of the external canthal ligament should be severed to release the tarsus. After healing there is no break in the continuity of the lid margin or in the row of eyelashes.

2. *Laceration of the Lower Lid from the Inner Canthus Downward and Outward.*—This type of deformity is seen in many cases of war injury, as well as in injuries of civil life, and the fact that failure to get proper healing with good results is the rule, and not the exception, is well known. Allow me to speak of an illustrative case and to mention a few points that make for success in the correction of the condition.

S. L. received a gunshot wound in action in the Argonne Forest, November 1, 1918. This resulted in rupture of the

ILLUSTRATING DR. WHEELER'S ARTICLE ON "WAR INJURIES OF THE EYELIDS."

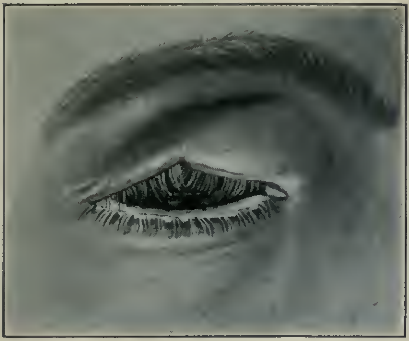

Fig. 1. Case 1. Notch in upper eyelid due to laceration through the tarsus.

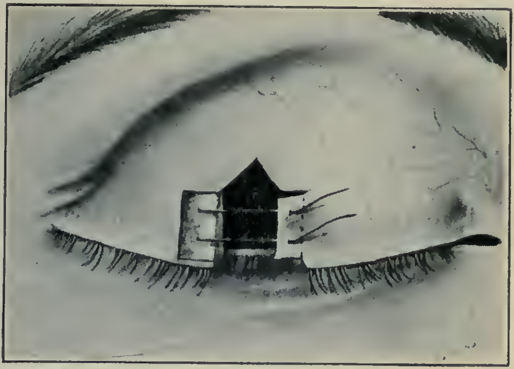

Fig. 2. Case 1. "Halving" operation. Dissection has been made. Mattress suture is shown passing through denuded tarsus on temporal side and flap of skin on nasal side.

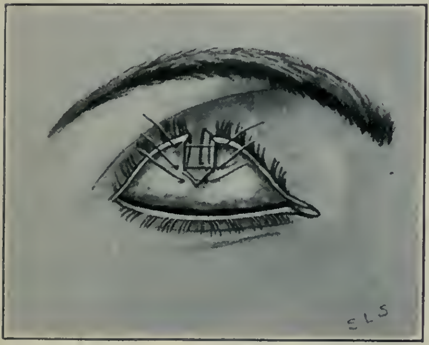

Fig. 3. Case 1. "Halving" operation. Lid everted. Conjunctival sutures ready to tie.

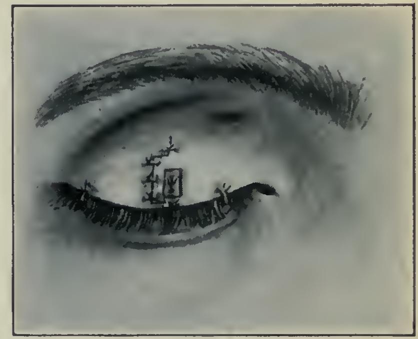

Fig. 4. Case 1. "Halving" operation. Sutures tied. Mattress suture passed through rubber plate. Upper and lower lids sutured together.

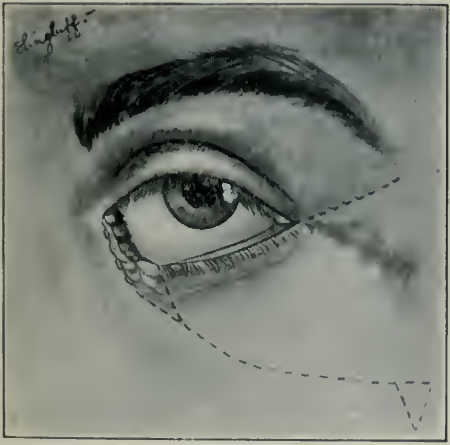

Fig. 5. Case 2. Laceration of the lower lid from the inner canthus downward and outward. Fracture of the superior maxilla and malar bones. Dotted lines indicate incisions.

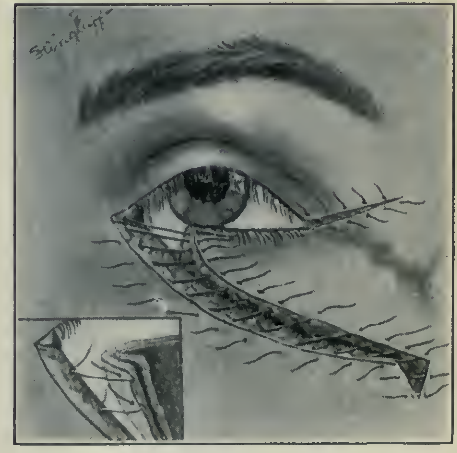

Fig. 6. Case 2. Dissection completed and sutures placed for advancement of lid flap, and repair of conditions shown in Fig. 5. Insert shows a splitting of flap to increase healing surface.

choroid (left eye), a laceration through the canaliculus of the left lower eyelid, and fracture of the left malar bone, with slightly depressed scars in the malar region. The coloboma of the lid is shown in Fig. 5. Two attempts had been made to correct the deformity. A mass of scar tissue was associated with the gap.

In this type of injury it is a difficult matter to get the apex of the lid flap to adhere accurately in position after operation. Usually it heals in a position too low, and usually fails to lie back in contact with the globe. For a good corrective result the apex of the lid flap should be fully up and back in position. Moreover, no new deformity should be added in the process of repair. In some of our cases that have had reparative procedures we have noticed deformity due to differences in the area of the two healing surfaces. In such cases the raw surface of the lid flap is liable to be more narrow than that of the nasal (stationary) flap. Furthermore, in some cases received at Fort McHenry, where there was incomplete adhesion of the two raw surfaces, it was evident that there had been no repair of the conjunctiva, which was concerned in the injury.

Fig. 5 is from a photograph before operation. No idea can be gained from the photograph of the amount of cicatricial tissue present at the site of the wound. Even on examination of the patient himself one is liable to underestimate the extent of subcutaneous scar tissue formation in such cases. *This cicatricial tissue should be entirely removed*, even if the sacrifice seems great at the time of operation. There should be no compromise on this point, or failure may result from nonunion of the flaps or from breaking down of the tissue.

The incisions shown in Fig. 5 should be long enough to insure the possibility of sufficient advancement of the flap so that the end will fall into position without any tension whatever, after most of the sutures have been introduced.

Suturing.—Suturing should be started at the base of the movable flap and placed in such a way that the interspaces are greater in the stationary skin than in the movable lid flap. This difference in spacing should be greatest near the base of the flap, and should diminish toward the apex. In other words traction should be greatest at the base and should diminish toward the apex of the lid flap, and at the end of the flap there should be none at all.

Anchorage.—Proper anchorage of the angle of the lid flap backward and upward in a position of slight overcorrection is important. This can be accomplished by carrying the skin sutures through more deeply in the tissues on the nasal side than in the lid flap, and by anchoring the apex back to the canthal ligament, carrying the angle of the lid flap as high as possible.

Drainage.—This is advisable in all plastic work of this kind. My preference is to avoid ligatures for bleeding vessels, and to rely on pressure and artery clamps to control hemorrhage during operation. In the tissues about the eyes, subcutaneous ligatures of any character are liable to cause trouble either early or late after operation. However, avoidance of ligatures on vessels leaves the possibility of the formation of a hæmatoma after operation, and this may become infected, and cause the wounds to open. A small gauze drain introduced at operation, and allowed to remain for a few days, is good preparation for such a possible mishap. The drain should be at or near the base of the flap.

Splitting the Margin of the Lid Flap.—In operating in this type of injury, the surgeon may be confronted with a discrepancy in the raw areas which must be brought in apposition. The margin of the lid flap is apt to be too narrow. It is important that apposing raw surfaces should match. A simple and effective scheme is to split the lid flap at its edge, as shown in the insert in Fig. 6, and thus increase its healing surface enough so that it will cover the apposing healing surface. The conjunctiva should be carefully sutured before the skin sutures are placed in the end of the flap. Fine silk thread should be used in the conjunctiva, and the sutures should be tied toward the eyeball.

Tension of Flaps.—Effective relaxation is important. Fig. 7 shows a good method. Strips of adhesive plaster are equipped with small hooks. Ordinary dress hooks, as suggested by Captain C. E. Nutter, are entirely satisfactory. Small perforations are made in the adhesive strips, and the hooks are slipped through; then the adhesive plaster is turned so as to inclose the base of the hooks, which cannot slip through the openings. The adhesive strips are placed so that the proper traction will be produced to give relaxation of the flap. A rubber band is strung between the hooks to produce tension. Elasticity is essential to produce continuous traction, and I do not hesitate to recommend this method highly. The skin sutures should be removed in four days, to prevent the possibility of pus formation about them, and to prevent suture scars, but the relaxation apparatus should be kept on for ten days to two weeks, to assure strong union with the eyelid in the proper position.

Fig. 8 illustrates the photographic appearance three weeks after operation.

For suture material in this kind of plastic work linen thread dressed with paraffin and vaselin or with a beeswax preparation is most satisfactory. It is stout and pleasant to handle, and is not given to absorbing blood and serum to invite infection and pus formations.

In cases with injury to the lower canaliculus and impairment of lacrimal drainage, epiphora may be annoying, and removal of the main lobe of the lacrimal gland gives relief. In the case mentioned, and in similar cases, we have practiced extirpation of the gland with satisfactory results.

3. Laceration of Lower Lid Near Inner Canthus with Coloboma and Cicatricial Ectropion.—In order to bring out two more points in the repair of the type of case just mentioned under the second heading, I wish to speak of another case belonging to the same type.

> Private T. R. received a gunshot wound, causing a laceration through the lower canaliculus of the right eyelid, a marked ectropion, a large coloboma, and a heavy mat of scar tissue, overlying a fracture of the superior maxillary bone. Fig. 9 is from a photograph taken on the patient's admission to General Hospital No. 2 at Fort McHenry.
>
> The mass of scar tissue was excised, and several small foreign bodies were removed. I might say in this connection that in war wound cases foreign particles are almost always found in the dissection of scar tissue, and sequestra are occasionally encountered. A free canthotomy was performed, and an incision was carried upward and outward from the outer canthus.

Fig. 10 shows the lid flap that was shaped, the drain, and the skin sutures in place. What I want to emphasize here particularly is the advantage that was taken of the fact that a very small area of skin was left uninjured at the inner canthus. This was dissected up carefully and was preserved uninjured. Unless such cases as this have been subjected to operations, usually some such little flap of skin can be seen, and by delicate dissection lifted from its bed. In removing the scar tissue and the skin involved in the cicatrix, care was taken to save a little flap of tarsus. In suturing, this little tarsal flap was slipped behind the little skin flap, and held there by a mattress suture, tied so as to assure apposition of the raw surfaces, but not too tightly. Then the end of the tarsus was anchored upward and backward securely by a suture which passed through it and through the canthal ligament. It is safe to tie such a suture snugly. In the healing process in this case there was no slipping of flaps. One can afford to sacrifice healthy skin of the lid when it seems very scarce, in order to get such a little flap of tarsus to help in the "halving" process. I think too much stress cannot be given to this idea.

The other point which I should like to make here is in regard to the value of a beveled incision such as was used in part of the dissection in this case, and shown in Fig. 10. After all scar tissue had been dissected out, an incision was carried downward and outward, and a triangle was removed from the lower flap at the temporal end of this incision. Obviously, this was done to allow advancement of the lid-flap for adjustment. In making this deep downward and outward incision, it was carved in a slanting (beveled) fashion instead of directly backward at right angles to the skin surface. Two important things are accomplished by this maneuver. First, permanent depression of the scar is largely avoided. Second, a larger healing area is afforded the flaps.

Fig. 11 is a photograph taken about three weeks after operation to show the lower eyelid in place.

4. Coloboma at the Outer Canthus.—This is a less common war injury than those already spoken of.

Corporal F. G. was wounded by high explosive in action on September 21, 1918, at St. Mihiel. Fragments produced rupture of the left eye. Enucleation was performed. Fracture of the left malar bone resulted, with wounds of the soft parts in the malar region. On admission to General Hospi-

ILLUSTRATING DR. WHEELER'S ARTICLE ON "WAR INJURIES OF THE EYELIDS."

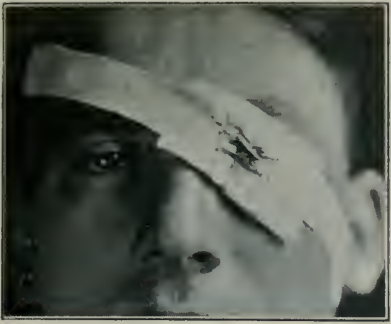

FIG. 7. Case 2. Elastic relaxation applied at completion of operation.

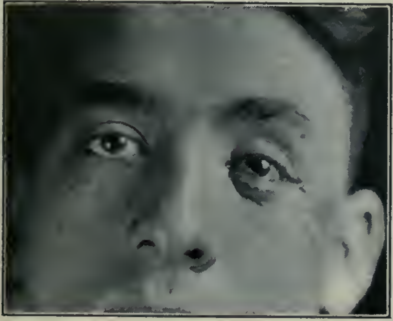

FIG. 8. Case 2. Three weeks after operation.

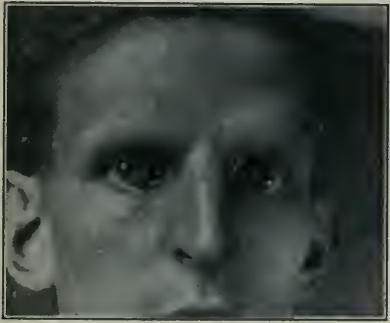

FIG. 9. Case 3. Laceration of lower lid near inner canthus with coloboma and cicatricial ectropion. Fracture of orbital margin.

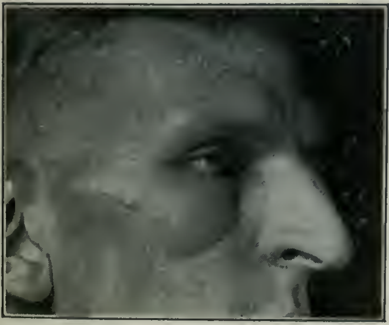

FIG. 11. Case 3. Three weeks after operation.

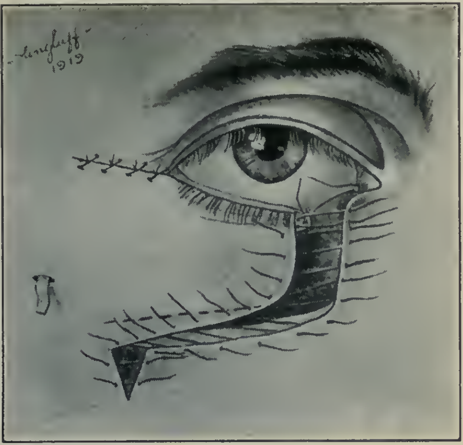

FIG. 10. Case 3. Dissection. Sutures ready to tie. Note dissection at inner canthus, exposed nasal end of tarsus, and beveled incision.

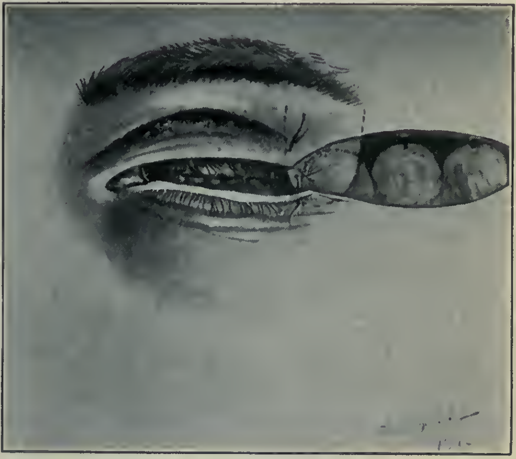

FIG. 12. Case 4. Coloboma at outer canthus, fracture and depressed scar. Dissection has been completed and subcutaneous grafts have been turned into depression.

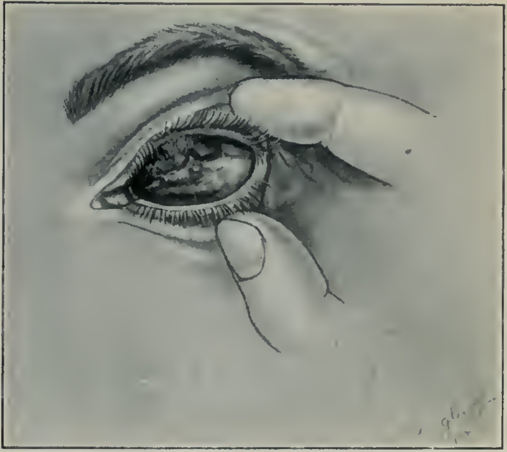

FIG. 13. Case 4. Cul-de-sac and outer canthus two and a half months after operation.

tal No. 2, Fort McHenry, the left eyelids were widely separated at the outer canthus. The outer part of the lower lid was everted, and a heavy depressed scar formation extended back one and one half inches from the outer end of the eyelids.

Operation.—Ether, March 22, 1919. The mass of scar tissue was largely excised, and the skin widely undermined in both upper and lower flaps. Subcutaneous grafts were everted on pedicles and sutured in position to fill in the depressed area. A subcutaneous graft was turned on the external orbital margin, and to this the conjunctiva was sewed. Another graft was turned over on the first, overlapping it in such a way that the nasal margin of the flap would shelve over the graft underneath. To the second graft the skin was sutured at the temporal ends of tarsi to make an outer canthus. In this way the cul-de-sac was made behind the newly formed canthus. The skin flaps in the malotemporal region were brought together by silk sutures. The handling of this case illustrates an important means of filling in depressions and reconstructing the outer canthus.

In this case there were three important objects to be attained. One was to fill in the unsightly depression behind the orbital margin. A second was to form a permanent cul-de-sac behind the outer canthal region. The third was to make a sightly outer canthus. In this case, to attain the first object, subcutaneous pedunculated grafts were used as filling. These grafts consisted of fascia, fat, and muscular tissue, and were cut so that their pedunculated bases were toward the depressed area, and with the attached bases as hinges were simply turned upside down into the depression and sutured in place (a single suture is enough for each flap). In order to get the proper adjustment of tissues for the formation of the canthus and the cul-de-sac which must reach behind the tissues at the canthus, care was taken in the placing of overlapping grafts, to the nasal margins of which first the conjunctiva and then the skin were anchored. In Fig. 12 an effort has been made to show the arrangement of the subcutaneous flaps and the manner in which the outer cul-de-sac and outer canthus were constructed.

In using subcutaneous grafts with pedicles it is important that the grafts should not be too large. It is better to use a series of small grafts than one large one, as there is much less reaction following operation, less danger of their breaking down, and, most important of all, less deformity occasioned by operation. It is necessary to overcorrect slightly, in filling in depressions with subcutaneous grafts, as well as in the use of free grafts. Probably the depression in this case could have been filled in satisfactorily by the use of fascia lata, but free grafts would have made unsatisfactory anchors for the conjunctival and skin tissues at the outer canthus.

Fig. 12 shows the operative field after the mass of scar tissue had been removed, and the skin trimmed, and with the pedunculated grafts turned into the depressed area.

Fig. 13 illustrates the appearance of the outer canthus two and one half months after operation.

NOTES ON VERNAL CONJUNCTIVITIS[1]

By W. H. LUEDDE, M.D., F.A.C.S., St. Louis, Mo.

PERHAPS no better introduction to a discussion of vernal conjunctivitis can be found than the following paragraph from Axenfeld's (1) comprehensive report to the Société Française d'Ophtalmologie in March, 1907: "But the pathogenesis having remained obscure, the treatment largely inefficacious, the pathological anatomy disputed on important points it shall be our duty in this report to show what progress we have made in these latter years, which questions remain to be clarified, and how the researches of the future must be directed to lead us in the end to an interpretation of this disease which is one of the most distinctive and yet one of the most strange in the entire range of pathology."

These words serve well even to-day to define the attitude of ophthalmologists toward vernal conjunctivitis. Duane's edition (Fifth-American) of Fuchs's *Textbook of Ophthalmology* (2) reads as follows: "The prognosis is therefore good as regards the ultimate outcome, but bad as regards the duration, as up to the present time, we know of no remedy for curing the disease or for preventing its annual return. The cause of the disease is unknown."

Vernal "Conjunctivitis," as de Schweinitz (3) very properly insists it should be named instead of "Catarrh," though relatively rare is an unusually interesting clinical entity. Its literature has become quite extensive. Axenfeld (1) appended one hundred and thirty-five references to his report. That number could easily be increased now to more than two hundred. In this connection only a consideration of some salient points of etiological, pathological, or therapeutic significance will be attempted with a few case reports outlining a simple and apparently efficacious method of treatment.

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[1] Candidate's thesis, American Ophthalmological Society, 1919.

Etiological Factors—(A) Heat:

Haab (4) states that this disease is of special interest, because with the exception of miliaria, it is the only one affecting the human body, entirely dependent on "Heat" so that in cool summer seasons, it really does not develop. The persistent and regular return of the symptoms coincident with the advent of warm weather in spring or summer is the one fact upon which a diagnosis can be based with absolute assurance in connection with the clinical manifestations of this disease. While heat may be the immediate exciting factor it cannot be the sole cause. Only a small fraction of all eye patients have vernal conjunctivitis. The greatest frequency, reported by Trantas (5), (Constantinople) is about 1% of all patients, indicating that only a very small fraction of the general population are thus afflicted. Nearly all patients eventually attain to a recovery spontaneously after which the inexorable return of summer heat fails to develop the characteristic ocular symptoms. That the recurrence is determined by heat rather than by habit is evident from the experience of a young Argentinian observed by Morax (6) who for more than ten years had annual attacks at Buenos Ayres in November, December, and January. He came to Europe in October, 1904, and had no trouble until the following June when the disease returned with marked severity.

(B) Climate:

The influence of climate may be exerted on the conjunctival sac through dessication, wind, and dust, or by sunlight alone. Preponderance of evidence seems to justify the statement that where dry heat prevails vernal conjunctivitis is more prevalent than wherever the spring and summer seasons are associated with great humidity.

Bartels (7) stated that the rarity of vernal conjunctivitis in Lima and its frequent occurrence in southern Peru tends to confirm hot, dry, dusty, air as a cause. Herbert (8) saw thirty-nine cases in Bombay in two and a half years, but the discussion of his paper showed that the disease is rare in England where a relatively high degree of humidity prevails.

Jackson (9) reports forty-four cases collected in Denver during fifteen years, and adds that "ten years previous acquaintance with the disease in Philadelphia seems to indicate that it is more common in the dry elevated region of the Western United States." Feingold (10) states that "if unusual heat were to be the cause, New Orleans with its long summer should show a great deal of vernal conjunctivitis, but that it is characteristic of our city that no vernal conjunctivitis is seen or only in abortive cases." This apparent contradiction is in a large measure explained by the following additional statements (11) concerning the climate of New Orleans—"The precipitation exceeds sixty inches—New Orleans shows a maximum during June, July, August. The sky is clouded 50% of the winter season and 40% of the summer." Thus the great humidity and frequent relief from dusty winds by copious rainfall so modifies the usual effect of unchecked heat and dryness that Feingold's report is not unusual. Hosch (12) found that the conjunctivitis of springtime did not develop until summer if the former season were cool and moist and that prolonged rains in summer produced temporary relief. The reports of Saemisch, Schmeichler, Fuchs, Nils Remmen and Webster Fox are quoted by Axenfeld (1) as confirming the etiological importance of heat and drought. Danvers (13) reports on records of fifty cases of vernal conjunctivitis collected at Parma in his thesis for the Italian diploma of medicine. He seemed to find that humidity increased the frequency. In Italy the greatest rainfall occurs in fall and winter. The summers being so dry that the small river beds become dry and irrigation is often needed to ensure crops. It is hardly possible therefore to compare the occasional relative humidity during the dry summer season in Italy with other sections where the percentage of humidity is both high and constant. Given a dry and dust-laden atmosphere, it is to be expected that exposure to strong wind will increase their irritant effect on the conjunctiva. The more frequent and prolonged exposure out of doors may account for the greater frequency of vernal conjunctivitis among the rural population as noted by Weeks (14) and also by Danvers (13), thirty-three of whose fifty cases were from the country. Besides, in most cities more or less efficient methods are in use to lay the dust.

Bayer's experiments with transparent occlusive dressings seem to exclude any pathogenic effect of light, *per se*. Feingold (10) confirms this report by his own tests. Axenfeld presents the following tabulation reported by Widmark, Sweden, which tends to show that the prolonged illumination during summer in the higher latitudes is not an exciting cause.

	Latitude	*Hours Longest Day*	*(Fahrenheit) Average Temperature*	
			June	*Annual*
Haparanda (one case)	66	22½	53.0	32.5
Hernoesand (none in 10 years)	62	20	54.5	38.0
Gefle (one in 5000 —4 years)	60.5	18½	56.4	40.0
Stockholm (58—53402—14 yrs.)	59.5	17½	57.2	41.5
Lund (3 in 5600)	56	15½	61.5	45.0

(C) Microörganisms:

According to Weeks (14) and Kalt (15) a good argument may be made for the bacterial origin of vernal conjunctivitis. Axenfeld (1) finds no reason to affirm bacterial origin but says the possibility can not be denied without further research.

(D) Predisposition:

No matter what theory is advanced to explain vernal conjunctivitis, it is impossible to deny that individual susceptibility varies greatly even among those afflicted with the disease. Both general health and local conditions must be considered in this connection. Its spontaneous cure after an uncertain period and occasional relapses also indicate that the immunity is not constant.

The greater number of sufferers from vernal conjunctivitis belong to the male sex. Saemisch (18) reported that 79% of his 185 cases were males. Trantas (22) of Constantinople reports 90% males, and refers to the possibility that the greater frequency among Turkish men is due to their wearing of the fez which affords no protection for the eyes. Edward Jackson (9) reports 57% males, and states that the preponderance might be easily accounted for by more general exposure to light and dust.

The disease usually begins between the 6th and 20th years of age, although exceptional cases are reported beginning earlier or later. Jackson saw one case beginning in a woman seventy-five years of age and recurring for three successive summers. The average duration is placed by Saemisch (18) at four to six years, but Gasparini (23) reports histological studies of an eye of a patient sixty-four years of age who had suffered from the disease for fifty-two years.

Race and consanguinity seem to be negligible factors so far as vernal conjunctivitis is concerned. Morax (6) Fuchs (24) report instances where two children of the same family were afflicted while other children showed no ocular disturbance at all. Angellucci (25) and Wechsler (26), each saw a child with vernal conjunctivitis where a parent had previously suffered from the same disease. An additional case is reported by the writer in this series.

Careful studies of the general health have failed to reveal any condition sufficiently constant to be directly associated with individual susceptibility. For example, Axenfeld (1) quoted reports of general lymphocytosis which coincided with his own investigations. His view was endorsed in subsequent discussions by Gallemaerts, Brussels (27), who had noted an increase of eosinophile lymphocytes, but was directly contrary to the results of tests reported by de Lapersonne (28), where the blood was found absolutely normal on repeated examination. More recently, Butler (29) reports a slight but constant eosinophilia.

The same incompatibility of evidence seems to pertain to anemia and other general nutritional changes. Botterri (30) states that all patients were strong peasants and showed marked pigmentation while Schleich (31) reports low nutrition and anemia constant. Von Michel (32) at one time insisted that the underlying malady must be one involving the entire system of lymphatic ganglia, therefore hereditary lues must be considered. Equally futile have been attempts to establish any relation between vernal conjunctivitis and general or local tuberculosis.

Boé (33) regrets that the disease is not serious enough to permit studies on the effect of transfusion of blood between susceptible persons, etc. He refers to a case where an attack of puerperal fever suddenly and totally eliminated vernal conjunctivitis.

Local or general skin diseases, diseases of the nose, hay fever, or other types of conjunctivitis may be coexistent but have shown no constant etiological relation to vernal conjunctivitis.

(E) Location:

Vernal conjunctivitis is strictly a local disease. Its most typical alterations involve the conjunctiva on the tarsus or at the corneal limbus or both. General congestion of the ocular conjunctiva when present, is secondary to the intense itching and photophobia. Often the ocular congestion is localized about one or several points of the limbus in such a way that this disease was designated as "Phlyctæna pallida" by V. Graefe (34).

Some patients show changes at the limbus only giving rise to the name "Perikerato conjunctivitis exuberans" applied by Carmoney Valle (16), Mexico. In others the typical alterations in the tarsal conjunctiva predominate. Many show a combination of these but of variable severity. In some, even that very unique and almost constant objective clinical sign of the disease—the "bluish milky" surface reflex, is missing. Jackson (9) found it present in only seventeen of his forty-four cases. The diagnosis is then dependent on a regularly recurring rather localized and characteristic congestion of the ocular conjunctiva with itching and mild photophobia.

These variations seem not to be limited by locality or climate. Conclusions based on any one series may be misleading. Larger numbers and longer periods give more nearly uniform results. Ahlstroem (17) in a collection of ninety-six cases found 50% were of the palpebral, 24% of the ocular, and 26% of the mixed type. Saemisch (18) found the mixed type much more abundant than either the purely palpebral or bulbar varieties. Trantas (5) reported 75% of mixed type. Stark (19) stated that the palpebral type was not seen at El Paso, Texas. Recent reports by Gonzalez (20) and Fernandez (21) indicate that both bulbar and palpebral types are to be found in Mexico and Cuba.

Why is it thus localized? It is possible that some reason may be found which might assist in a better understanding of the etiology. The significant fact that these are the portions of the conjunctival sac where the conjunctiva is *firmly attached to its base* has apparently not received the attention it deserves. The conjunctiva of the fornix and the ocular (bulbar) conjunctiva throughout—except at the limbus where its epithelium merges with that of the cornea, is freely movable over the underlying connective tissue, and is actually kept in motion—except during sleep—by incessant movements of the globe and lids. Such mobility means increased circulation, both in the blood-vessels and the lymphatics. This in turn means better local nutrition and the more efficient elimination of waste products.

According to Koeppe (35) the episcleral blood vessels are well supplied with lymphatics, even the finest capillaries being surrounded by relatively large spaces. These include the capillary loops at the limbus but contrary to the theory of Von Recklinghausen (36) they do not anastomose with the corneal lymph spaces. The flow of lymph therefore is probably somewhat sluggish at this fixed terminus of true conjunctival tissue which Morax (37) calls *une portion intercalaire.*

That the circulation of the scleral and ciliary vessels at the limbus is more vigorous at the limbus than that of the conjunctival vessels is indicated by the fact that in conjunctival inflammations the congestion at the limbus is usually less than at any other zone of the ocular conjunctiva while the reverse is true with ciliary congestion. The recent examination of the eyes of a soldier burned August, 1918, with mustard gas, showed that the cicatricial zone of 2 to 3 *mm* width, surrounding the cornea, was supplied by new vessels branching from the deep ciliary vessels at the limbus while the network of conjunctival vessels stopped at the outer margin of this zone at a sharp line of demarkation. Furthermore there would appear to be no chance for either blood or lymph to flow as freely in the tarsal conjunctiva, closely adherent to a firm fibrous base as in any other part of the conjunctival area.

The notable epithelial proliferations of vernal conjunctivitis occur at the limbus where the stratified columnar epithelium of the conjunctival sac has been converted into the stratified squamous type to merge with epithelial covering of the cornea.

The papillary hyperplasia of connective tissue with hyaline degeneration occurs in the palpebral conjunctiva covered by the usual stratified columnar epithelium which seems to be but slightly disturbed by the process. The narrow band of smooth squamous epithelium at the lid margin where it merges with the skin, apparently forms the boundary for the changes incident to vernal conjunctivitis as it does for trachoma (Ball, 38).

Normally, there is considerable evaporation from the conjunctival surface. The loss is supplied by moisture secreted by the mucous membrane and only after exceptional irritation are tears supplied by the lacrimal gland. In the presence of greater heat and dryness, especially if there is any failure in the conjunctival secretory function, the parts likely to suffer first are those where the subconjunctival circulation is least elastic, probably at the fixed points as above noted. Though the greatest direct loss is from the ocular surface the movement of the eyelids distributes this loss rather uniformly over the tarsal conjunctiva as well. Probably most of the moisture for the surface of the cornea is normally supplied by the conjunctiva on the superior tarsus.

The first effect would thus be exerted on the epithelium, but the subepithelial reaction would be almost simultaneous. The question of priority among these changes has caused much discussion. Vetsch (39), among the earliest to undertake histological study of the disease, concluded that the epithelial proliferation is the primary and most important pathological change in the tissue. Axenfeld (1) believes that the inflammatory reaction develops in the conjunctival connective tissue and that the epithelial proliferations are secondary changes. According to Schieck (40) tissue proliferation and hyaline degeneration play the principal rôle—not merely in the conjunctiva proper, but in the underlying tarsal or episcleral tissues. Cellular infiltration seems to be entirely secondary. Kalt (15) and Ginsberg (41) point out that opportunity to study early cases alone can answer this question.

Adams (42) notes that in vernal conjunctivitis "there is very slight mucoid change," while in trachoma and follicular conjunctivitis mucoid changes are extensive. This modification of epithelial function may bear some relation to the intense itching through irritation of the nerve endings by the changed composition of the secretion.

As Chaillous (43) points out, itching probably precedes all other manifestations. In some cases, structural changes are so slight that only the ocular congestion and itching indicate the return of the disease with each spring or summer season. Perhaps the earliest structural change is drying of the superficial epithelial cells, provoking cell proliferation and extension downward as a natural reaction for protection against further drying. The most superficial cells may become homogeneous and lose their nuclear staining, thus simulating in appearance if not in actual change of substance, the Keratin lamellæ of the skin (Ginsberg, 41).

The special conjunctival nerve endings, Krause's corpuscles, differ from the Pacinian corpuscles of the skin by the absence of a thick laminated investment. They may be unusually sensitive to chemical irritants liberated by the effect of heat and dryness on the epithelium. The chemical changes incident to the loss of water, in the presence of sensitizing enzymes, may cause these cells to become the irritant factor provoking the tissue reactions which have been noted.

The itching and subsequent rubbing of the eyelids may inoculate these dried cells into the sensitized tissue producing locally the reaction of an anaphylatoxin. Leucopenia and eosinophilia are noted as general effects of anaphylactic toxin (Wells, 44). Such a local reaction might be assumed from the abundance of eosinophiles and the slight local lymphocytosis in vernal conjunctivitis as compared with trachoma, follicular catarrh, etc. The tissue reaction could be explained in this way without recourse to a specific bacterial infection. According to Pereyra (45) eosinophiles are present in various types of conjunctival inflammations and are constant in "provoked" conjunctivitis from drugs or superficial caustics.

If the itching were present only where hyaline deposits are found, chemical or mechanical irritation from that source might be to blame. On the other hand, the subjective discomfort ceases with cool or damp weather, but the hyaline deposits often show but little change between seasons. Hence it seems unlikely that they are concerned in producing these symptoms.

Practically at the same time, a subepithelial hyperplasia of connective tissue ensues. If this pushes upward between these epithelial invaginations, nodules are formed. These differ from the lymphoid granulations of trachoma by containing relatively few lymphocytes, but a marked predominance of connective tissue cells with more or less hyaline degeneration. The thin layer of hyaline degeneration may extend quite uniformly throughout the conjunctival sac (equals degenerative changes of the ground substance fibers and interfibrillary exudates), producing the "bluish milky" or opalescent reflex. Relatively few blood vessels are found in this new hyperplastic tissue and its products.

The presence of hyaline is so constant that it appears to be another phase of nature's defense against the irritant agent or organism producing this disease. According to H. G. Wells (45) "there is no one chemical compound 'hyaline' which accumulating in cells or tissues produces a hyaline appearance." He describes a form of hyaline observed in scar tissue which develops after the blood supply has been reduced to a minimum and states that presumably it is "similar in nature to the collagen of normal fibrous tissue intercellular substance which has undergone physical rather than chemical changes into a homogeneous hyaline substance. It has for its physiological prototype the thick 'collagenous' fibers of the subcutaneous connective tissue."

Axenfeld (46) suggests that the characteristic "bluish milky" reflex of vernal conjunctivitis is due chiefly to the subepithelial homogeneous sclerosis of proliferated connective tissue but states that epithelial thickening may have a part in it. According to Stoehr (47) the superficial cells of the stratified columnar epithelium normally show a thin hyaline cuticular seam.

If we attempt to generalize from these reports, it would appear that the deviations in the histological structures of the conjunctiva tend to approach the epidermal structure, both by the pseudo-keratinization of the epithelium, and by the formation of hyaline in subepithelial connective tissue. These changes do not occur where the vascular and lymphatic circulation is unusually abundant nor in the fornices where the drying out process is prevented primarily by the lack of exposure.

This analogy is masked through a number of secondary developments. Unusual large masses of epithelial proliferation with cystic degeneration (Antonelli, 48) at the limbus are reported. Large localized relapsing nodules of connective tissue develop in the tarsal conjunctiva which do not fit into this general picture of temporary epidermization of the conjunctiva in vernal conjunctivitis. However, once the provocation for connective tissue or epithelial proliferation having been supplied, it is not impossible for the special local developments which have been reported in connection with this disease to occur. A long standing relapsing process need not conform to the original typical defensive process incident to summer heat and dryness.

During the fall and winter season, the conjunctival tissues usually manifest a strong tendency to return to normal through absorption of necrotic tissues and through the regular development of connective tissue cells into normal fibrous structure. In the torrid zone according to Gonzalez (20) and Fernandez (21) the difference in temperature is so slight that the return to normal is practically never accomplished, though the acute symptoms disappear. Parsons (49) also reports that his observations indicate but little change due to change of season.

Therapeutic Measures:

A simple and certain method of securing relief from the annoying symptoms of vernal conjunctivitis noted by Axenfeld (1) was the occlusive dressing. As above noted, it was not found necessary to exclude both light and air. A transparent covering for the eyes was sufficient to obtain much relief, but the symptoms returned whenever the dressing was discontinued in warm weather. These limitations hardly make of it a practical or popular remedy.

A large number of reports in recent years indicate that if properly applied X-rays or radium will produce marked amelioration of the discomfort, prevent relapses, and apparently cure vernal conjunctivitis.

The experiences of Allport (50), Pusey (51), Butler (29), Shumway (52) are convincing on this point. Radium is more popular than X-rays. Sufficient experience has apparently been accumulated to permit an accurate estimate of the proper dosage of radium with entire freedom from harmful effects.

According to Wells (53), X-rays stimulate cell-growth when applied in small amounts, but larger amounts produce necrosis. Immature cells and cells in active division are more sensitive than adult cells. Radium shares with X-rays the power of causing tissue necrosis and produces general lymphocytosis after prolonged exposure. They both have marked effect on metabolism and radium seems to stimulate the action of most enzymes. The favorable effect of X-rays and radium may be explained probably by their effect on local metabolism rather than by any bactericidal power. According to McCallum (54) "Roentgen rays have little injurious effect upon bacteria, but the 'Alpha' and 'Beta' rays from radium kill them directly."

By checking the new growth and promoting absorption of hyperplastic tissue, and by increasing the lymphocytosis, X-rays or radium might be expected to exert a very favorable influence on the course of the disease. Their effect on the enzymes or local sensitizing substances may also be a factor in the good results reported from their judicious use in vernal conjunctivitis.

Personal Experience:

The writer has not used X-rays or radium for this disease. His experience during the last eight years with a more simple remedy in the nine cases coming under his care has been eminently satisfactory.

CASE I.—*1911, June 7th.* Alma S. Aged 10. Eyes inflamed each spring until fall for last five years. Typical vernal conjunctivitis—palpebral changes predominate. Simple eyewash with adrenalin $\frac{1}{10}\%$ daily for one week without effect. First application of AgNo$_3$ ($\frac{1}{5}\%$) followed by *fibrolysin* to everted eyelids brought marked relief within a few minutes. Complete cessation of all subjective irritation occurred within a few days. Treatments continued two or three times weekly until August and at longer intervals until October. There was *no* return of symptoms. Kept under observation and treatment repeated once a month during following winter and summer (*1912*), there being absolutely no recurrence. Monthly treatments during next summer, *1913*,—no recurrence. Treated once only in *April, 1914*, instructed to report if any recurrence—there was none. No recurrence during *1915*. In *1916*, April 10th, had acute catarrhal conjunctivitis—no resemblance to vernal type—no itching—considerable secretion—recovered within one week using argyrol solution 20% twice daily.

CASE 2.—*1911.* Boy. Aged 10. At Eye Clinic, O'Fallon Dispensary, Washington University Medical School. Typical vernal conjunctivitis—positive relief from discomfort after use of *fibrolysin*—case disappeared.

CASE 3.—*1912, July 12th.* Virginia G. Aged 8. Residence Central, Texas. Typical vernal conjunctivitis palpebral changes, causing diagnosis of trachoma by general practitioner at home with painful and ineffective treatment. Recurrent attacks in spring and summer for four years —intense itching and considerable photophobia. Use of AgNo$_3$ (⅕%) and *fibrolysin* followed by immediate relief. Applications repeated daily for ten days, when patient returned to Texas. Prescribed *fibrolysin* every two days and a mild zinc solution for daily use—remained comfortable rest of season (report by letter).

1913, May 20th.—Mother reports by letter, "Can't come to St. Louis until August." Advised use of *fibrolysin* every other day and zinc wash as before. Reports in person *August 1, 1913.* No nodules in palpebral or ocular conjunctiva—very thin opalescent film remains on conjunctiva, but subjectively *very* comfortable. Reports by letter *Feb. 19, 1916* —Doing well enough to require no treatment since *1913.*

CASE 4.—*1913, May 16th.* Ruth Z. Aged 26. Residence, Warren Co., Missouri. Eyes inflamed each year during hot weather as long as she can remember. Worse last two weeks "on account of housecleaning." Slight proliferation at limbus of right eye. Palpebral conjunctiva shows no sign of vernal conjunctivitis. Used AgNo$_3$ (⅕%) and *fibrolysin*, right and left. Prescribed zinc sozoiodolate solution (⅕%) twice daily.

June 5th.—Returns. Proliferations *now* typical of vernal conjunctivitis at limbus, right eye—tarsal conjunctiva beginning to be involved right and left. Rendered subjectively comfortable after use of AgNo$_3$ (⅕%) followed by *fibrolysin.* Prescribed *fibrolysin* to be dropped on everted eyelids right and left once daily, *stopping* zinc solution.

July 3d.—Doing well until "hot spell' a few days ago. Palpebral conjunctiva *now* shows typical nodules of vernal conjunctivitis. Remained five days for daily treatments. Use of AgNo$_3$ (⅕%) and *fibrolysin* followed by subjective comfort except late at night. Directed to resume zinc sozoiodolate solution (½%) night and morning and continue use of *fibrolysin* every two days. Remained comfortable for remainder of *1913*.

1914.—No recurrence—no treatment.

1915.—No recurrence except slight discomfort at San Francisco Exposition. No treatment.

1916, July 17th. Returns. Inflammatory symptoms began last month, during intense hot spell. Smear shows eosinophile cells. Used $AgNo_3$ (⅕%) and *fibrolysin.* Itching stopped immediately after first treatments and did not recur. Returned home—directed to resume former home treatment. Promised to report any future recurrence. No report to date.

CASE 5.—*1915, June 12th.* John E. Aged 11. Typical vernal conjunctivitis began six weeks ago—marked thickening at limbus right and left. Severe burning and itching. Used holocain solution (1%), $AgNo_3$ (⅕%), and *fibrolysin.* Subjectively entirely comfortable after first treatment and eyes appear better on inspection. Treatments repeated every two days until June 24th when he ceased to report for treatment, because he was doing entirely well. *1916, Feb. 20th.* Father reports by request—states boy had no further trouble and promises to report if he has.

CASE 6.—*1915, June 15th.* Physician. Aged 39. Conjunctival congestion simulating phlyctenulæ at limbus one or both eyes, recurring regularly in spring and summer. No palpebral signs, no opalescent film. Initial attack twenty years ago nearly coincident with first attack of malaria which has since shown decided chronicity but no relation between attacks. Discomfort begins as early as April, if weather is dry and dusty, but more noticeable June and July. Cloudy weather and rain invariably brings some relief. Loss of sleep and travel seems to aggravate symptoms. Bathing eyes with either hot or cold water increases comfort. Wearing correction for astigmatism (+ 0.75 d. Cyl. Ax. Vertl.) increases comfort. Euphos, Amber, or Crooke's glass seemed to possess little advantage over plain glass for this purpose. Discomfort always less in morning but often worse during hot evening than during day. *Fibrolysin* used once on above date, arrested the attack for the summer *1915*—the latter part of which was spent in Colorado. No recurrence *1916* and *1917*—slight discomfort *1918*, and a slight recurrence in *April, 1919*—during an early warm spell. Being familiar with the rather harmless nature of these attacks and having very little discomfort during the last two attacks, he is watching for further developments before repeating the treatment.

CASE 7.—*1916, April 20th.* Frances D. Aged 53. Recurrent attacks of vernal conjunctivitis for 8 or 9 years characterized by itching, photophobia, and congestion of ocular conjunctiva. Tarsal conjunctiva smooth but shows opalescent film—no changes at limbus. Used holocain solution (1%), $AgNo_3$ (⅕%), and *fibrolysin* both eyes.

Following day. No photophobia nor congestion. Treatment repeated.

Three days later. Conjunctival irritation recurred after long automobile trip. Treatment same and directed use of zinc sozoiodolate solution (⅕%) at home night and morning.

Ten days later. Slight discomfort in right eye—used $AgNo_3$ (⅕%) and *fibrolysin* in right eye *only.*

Under observation for fifteen days longer for measurements of refraction but no further treatment used as discomfort had not returned.

Will report at once if it does.

1917, March 19th.—Slight return of symptoms of vernal conjunctivitis—used $AgNo_3$ (⅕%) and *fibrolysin.*

Three days later—very little itching, but some sensation of dryness since last treatment which was repeated.

Three weeks later—some itching after strong wind two days ago. Otherwise comfortable. Repeated treatment five times during next ten days, after which no further discomfort. Last seen in *January, 1918,* for readjustment of correction.

1919, May 12th.—Reports slight attack of ocular inflammation for a few days in April, 1918,—more severe attack this year (1919), lasting nearly a month. Some treatment by neighboring physician.

CASE 8.—*1916, Sept. 8th.* Geneva W. Aged 19. Eyes inflamed for two months. Much itching—worse at latter part of day. Similar attack during summer, *1915*. Eyelids show opalescent reflex of vernal conjunctivitis. Used Holocain solution (1%) $AgNo_3$ (⅕%) and *fibrolysin* on tarsal conjunctiva. Much better following day—treatment repeated.

Two days later—entirely comfortable—treatment repeated.

Three days later—slight discomfort—treatment repeated. Entirely comfortable through remainder of season.

1919, May 11th.—Her mother answers that patient had some conjunctival irritation during summer *1918*, but "not nearly so bad as before" and no recurrence during 1917—no treatment used since *September, 1916.*

CASE 9.—*January 29, 1919.* Lela I. Aged 9. Residence, Herculaneum, Mo.—Eyes inflamed in warm weather for last three years. Usually begins about April but itching and ocular congestion with photophobia began several days ago during this unusual spell of warm weather in midwinter. Typical opalescent film over tarsal conjunctiva both eyes with tiny nodules at limbus. Mother had similar attacks which began when she was about eighteen years of age. They recurred each summer for five years and then ceased spontaneously. Examination of mother's eyes reveals rather suggestive very thin milky film on palpebral conjunctiva though she had had no discomfort for ten years. Both the mother and the present patient are pronounced blondes.

Used Holocain solution (1%) and $AgNo_3$ (⅕%) followed by *fibrolysin*. Returns three days later reporting immediate improvement in comfort and less congestion. The mother did not conceal her surprise as all previous treatments during her own experience with the disease some years ago and for the last three years with her daughter had not been satisfactory. *Returns five weeks later.*—Eyes remained clear for some days, then some congestion at temporal limbus right eye. Palpebral conjunctiva remains smooth but shows pale opalescent film. Slight congestion at limbus on temporal side in each eye. Treatment repeated and directed to use zinc sozoiodolate solution (⅕%) twice daily at home.

1919, May 11th.—Mother reports child's eyes remained perfectly clear for two weeks after last visit and that symptoms now are so much milder that she did not wish to take her out of school to come to St. Louis for treatment.

This series of cases is too small to permit generalizations but the experience had been so satisfactory that it was mentioned privately to several ophthalmologists attending the meeting of the Colorado Ophthalmological Society in August, 1915. At least one, Dr. Robert Scott Lamb, had the hardihood to make use of *fibrolysin* in his own practice. He reports by letter as follows: "My first attempt was the corraling of *six* chronic recurrent typical and well-marked cases, well-known to have resisted all usual methods, put them in the hospital, under control, and use each night at bedtime, one drop of fibrolysin in each eye. Imagine my astonishment to find, at the end of ten days *all were well.* They were discharged from the hospital and requested to report to the out-patient department for observation once a week. There was no more vernal catarrh among them that season."

Dr. John Green, Jr., has kindly furnished the following case report:

> Girl. Aged 12, came under observation June 20, 1917.
>
> *Ocular history.*—For the past three summers her eyes have been inflamed with itching and photophobia. The condition clears up in the autumn. She has never missed a day of school on account of her eyes. Two years ago Dr. Brose of Evansville, Ind., removed tonsils and adenoids and gave eye-drops. Home doctor used "blue stone." The patient presented a well-marked case of vernal conjunctivitis of the palpebral type.
>
> Refraction:
> R + 1. sph. Vision $\frac{6}{4}$
> L + .75 sph. " $\frac{6}{4}$
>
> Euphos glasses gave some relief from the photophobia. After a few days treatment with a boric acid, cocaine nitrate and adrenalin mixture, fibrolysin was started and used every third day for three weeks. During this period, the patient was comfortable, the eyes opened more widely, and there was marked flattening of the palpebral plaques."

Of interest in this connection is the report of W. A. Sedwick (55) that in his first case presented to the Colorado Ophthalmological Society in August, 1917, the lids afterward became entirely smooth under local applications of *fibrolysin.*

Fibrolysin[1] was used in the first case as above noted, because it was believed that the absorption of the hyaline deposits might be accelerated and that an active lymphocutosis might modify favorably the course of vernal conjunctivitis. Clinical and experimental tests had shown that *fibrolysin* produced local lymphocytosis and promoted the absorption and softening of scar tissue. It had been used locally on the cornea and conjunctiva without injury. In fact, its use seemed to improve the resistance of corneal tissue, to aid materially in the cure of old indolent ulcers and in checking the progress of acute superficial corneal infections of every type.

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[1] "Fibrolysin—$CS(NH_2)NHO_3H_5\ \frac{1}{2}\ (C_6H_6—OH—COONa)$ Aqua. In order to avoid the pain caused by the subcutaneous injection of the alcoholic solution of thiosinamin (allyl-sulfo-urea), an aqueous solution of this compound has been prepared by F. Mendel. This was accomplished by combining one molecule of thiosinamin with one-half molecule of sodium salicylate. The resulting double salt forms a white crystalline powder which is readily soluble in cold water. The aqueous solutions are not stable to the action of light and air, hence are furnished in sterilized, sealed tubes containing 2.3*cc* of a solution, 1.5 parts of fibrolysin in 8.5 parts of water. Each tube represents 0.2*gm.* of thiosinamin. This is employed for resolving lupus grandular tumors, scleroderma, etc. (E. Merck.) Thiosinamin—CS, NH_2, NH, C_3H_5—a compound of ammonia and mustard oil, forming crystals of faint garlic odor, slightly soluble in water, readily in alcohol, fusing at 74°."

(Extract from *The Newer Remedies* by Virgil Coblentz, A.M., Phar.M., Ph.D., F.C.S., 4th edition—1908.)

The regular and persistent use of the remedy in the first case was possible because the patient, who had suffered much previously, was able and willing to report as directed. She apparently attained a complete cure.

Some of the other cases could not be followed up but the relief experienced by each while under observation was beyond question. In some of the later cases, *fibrolysin* was used as sparingly as possibly both because it was desired to measure the maximum effect of a minimum dosage and because, under war conditions, the preparation disappeared from the drug market, so that the small supply on hand was frugally conserved.

If one may hazard any conclusions as to the best therapeutic method from observations in such a limited number of cases, it would appear to be desirable not to depend on *fibrolysin* alone but to retain the use of silver or zinc salts in weak solutions for their beneficial effect on the epithelium. *Fibrolysin* seems to effect principally the subepithelial tissues. The use of Holocain solution (1%) just before using the *fibrolysin* proved to be desirable to shorten the period of burning usually accompanying the instillations of the latter solution.

For ocular treatments one or two drops of the solution of Fibrolysin as furnished in the sealed ampules without further dilution were dropped on the everted upper eyelids or directly on the cornea according to the effect desired. Rarely it was applied directly to the inflamed foci with cotton-tipped applicators. Treatments were repeated daily or at longer intervals according to results noted.

While the solution for hypodermic injections should not be exposed to light and air, no difficulty was experienced in keeping the same for ocular treatments in a well-stoppered amber vial for several months without apparent loss of efficiency or the development of noxious qualities.

Apparently two or three applications a week are sufficient to produce and maintain freedom from the discomfort even in severe cases and during the hottest weather. It seems that treatment at intervals of one month throughout the year can prevent relapses and bring about a cure in some cases. That effort is certainly worth while in the absence of all harmful effects when the remedy is thus used.

The report of these cases seems to be fully justified by the disappointments of the past in the treatment of vernal conjunctivitis. The use of *fibrolysin* should not mean the neglect of any measure calculated to promote the well-being of the patient, such as correction of eyestrain and reasonable protection from exposure and proper attention to the general health.

REFERENCES

1. TH. AXENFELD. "Le Catarrhe Printanier." *Bulletins et Mémoires de la Société Française d'Ophtalmologie.* 24th year, 1907, pp. 1 to 199.
2. A. DUANE. *Textbook of Ophthalmology* by Hofrat Ernst Fuchs. 5th edition, 1917, p. 206.
3. G. E. DE SCHWEINITZ. *Diseases of the Eye.* 5th edition, p. 275.
4. O. HAAB. *Aeussere Augenerkrannkugen.* 2d edition, p. 127.
5. TRANTAS. Ref. by Axenfeld (1), page 9. Also *Arch. d'Opht.*, 1905, p. 717.
6. MORAX. "Maladies de la Conjonctive." *Encyclopédie Française d'Ophtalmologie*, 1906, vol. v., p. 859.
7. BARTELS. "Einfluss der Trockenheit der Luft auf die Enstehung des Frühjahrskatarrh." *Klin. Monatsbl. Augenheilk*, 1914, lii., p. 482.
8. HERBERT. "Spring Catarrh." *British Med. Journal.* Nov. 2, 1907. (Ref. *Ophthal. Year Book, 1908*, p. 122.)
9. JACKSON. "Vernal Conjunctivitis." *American Journal Ophthalmology*, 1918, vol. i., No. 4, p. 263.
10. FEINGOLD. Discussion of Jackson (9). *American Jour. Ophth.*, April, 1918, p. 265.
11. "Louisiana." *New International Encyclopedia 1911*, vol. xii., p. 486.
12. HOSCH. Ref. by Axenfeld (1), p. 13.
13. DANVERS. "Spring Catarrh of Eyes." London, 1902. Ref. Morax (6), p. 857.
14. WEEKS. *Textbook on diseases of Eye*, 1910.
15. KALT. Discussion of Axenfeld (1), p. 172.
16. CARMONE-VALLE. Ref. Axenfeld (1), p. 7.
17. AHLSTROEM. Ref. Axenfeld (1), p. 53.

18. SAEMISCH. *Handbuch der Gesammten Augenheilk.* 1st edition, 1875, and 2d edition, 1904.

19. STARK. Discussion—Jackson (9), p. 266.

20. GONZALEZ. "Clinical Notes on Vernal Catarrh or Exuberant Pericorneal Conjunctivitis." *American Journal Ophthal.*, vol. ii., No. 4, p. 233.

21. FERNANDEZ. "Vernal Conjunctivitis in Cuba." *American Journal Ophthal.*, vol. ii., No. 4, p. 241.

22. TRANTAS. Discussion of Axenfeld (1), p. 160.

23. GASPARINI. Ref. Axenfeld (1), p. 8. Also "Catarro primaverile." Pavia, 1904.

24. FUCHS. Personal communication to Axenfeld (1), p. 50.

25. ANGELLUCCI. Ref. Morax (6), p. 857. *Arch. di Ottalm*, 1898, vol. v., p. 270.

26. WECHSLER. Ref. Morax (6), p. 857. Also *Beitraege z. Augenheilk.*, 1897.

27. GALLEMAERTS. Discussion—Axenfeld (1), p. 186.

28. DE LAPERSONNE. Discussion—Axenfeld (1), p. 186.

29. BUTLER. "Remarks on Diagnosis of Vernal Catarrh and its Treatment by Radium." *British Journal Ophthal.*, vol. i., 1917, p. 411.

30. BOTTERRI. "Spring Catarrh." *Wien. Klin. Woch.*, 1916. Ref. *Arch. of Ophthal.*, vol. xlvii, p. 92.

31. SCHLEICH. Ref. Axenfeld (1), p. 55. Also "Das Wesen des Frühjahrskatarrhs." *Stuttgart Aertzte Verein*, 1897.

32. V. MICHEL. Ref. Axenfeld (1), p. 34. *Handbuch d Ophthalmologie*, 2d edition, 1890, p. 200.

33. BOÉ. Discussion—Axenfeld (1), p. 135.

34. V. GRAEFE. *Klinische Vortraege, A. von Graefe's.* Hirschberg, 1871.

35. KOEPPE. "Lymph Vessels of Bulbar Conjunctiva and Limbus." Graefe's *Arch. of Ophth.*, vol. xciv., p. 117. Ref. *Ophth. Year Book*, 1918, p. 47.

36. V. RECKLINGHAUSEN. Ref. Koeppe (35).

37. MORAX. "Anatomie de la Conjonctive." *Encyl. Franc. d'Ophtal.*, vol. i., p. 380.

38. BALL. *Modern Ophthalmology*, 1916, p. 281.

39. VETECH. "Ueber den Frühjahrskatarrh der Conjunctiva." *Inaug. Diss. Zürich*, 1879. (Ref. Nagel's *Jahresbericht u. d. Ophthalm.*, vol. x., p. 262.)

40. SCHIECK. "Beitraege zur Pathologie u. Path. Anatomie des Frühjahrskatarrhs." *Klin. Monatsbl. f. Augenheilk.*, 1907, xlv., p. 449.

41. GINSBERG. *Pathologische Histologie des Auges*, p. 67.

42. ADAMS. "Pathology of the Eye." *Oxford Med. Publications*, 1912, p. 22.

43. CHAILLOUS. Discussion—Axenfeld (1), p. 175.

44. WELLS. *Chemical Pathology*, 1918, p. 424.

45. PEREYRA. "Frequency of Eosinophilia in Spontaneous and Provoked Conjunctivitis." *Arch. di Ottal.*, vol. xxiv., p. 341. Ref. *Ophth. Year Book*, 1918, p. 55.

46. Axenfeld. *Lehrbuch der Augenheilkunde.* 2d edition, 1910, p. 332.

47. Stoehr. *Lehrbuch der Histologie.* 14th edition, p. 410.

48. Antonelli. Discussion Axenfeld (1), p. 140.

49. Parsons. *Pathology of the Eye*, vol. i., 1904, p. 86. Ref. Axenfeld (1), p. 14.

50. Allport. "Vernal Conjunctivitis." *Ophth. Record*, vol. xxvi., p. 395.

51. Pusey. "Treatment of Vernal Catarrh with Radium." *Journal A. M. A.*, vol. lxxi., p. 806.

52. Edw. A. Shumway. "Vernal Conjunctivitis—Radium Treatment." *American Journal Ophth.*, vol. i., p. 404. Vernal.

53. H. Gideon Wells. *Chemical Pathology*, 1918, p. 376.

54. W. G. McCallum. *Textbook of Pathology*, 1918, p. 373.

55. W. A. Sedwick. Discussion Jackson's Paper, "Vernal Conjunctivitis." *American Journal Ophthal.*, April, 1918, p. 266.

ROUTINE OFFICE MEASUREMENT OF STEREOPSIS.

By DAVID W. WELLS, M.D., F. A. C. S., Boston.

(*With one illustration on Text-Plate VI. and one illustration in text.*)

THE ocular estimation of the relative distance of two objects is the result of several psychic processes, some of which are possible to a person possessing but one eye. Of these, visibility, apparent size of objects known to be alike, and monocular parallax are the most important. The relative value of these different factors has been well stated by Eaton (*Brit. Journ. Ophthal.*, vol. iii., 1919). But Howard (*Trans. Am. Ophthal. Soc.*, 1919) has shown that while monocular judgments are valuable, the binocular parallactic angle is absolutely essential to any refinement of the faculty. The importance of this possession to the aviator he has demonstrated incontrovertibly. Just how valuable it is to the chauffeurs, engineers, and street-car motormen has never been critically determined.

When the facts are known it is quite possible that visual tests will not stop with measuring the acuity of each eye and color sense, but that a certain standard of stereopsis will be required.

In 1899, Pulfrich (Zeiss) introduced stereoscopic instruments for measuring distance. In using these it was found that some did not possess the requisite stereoscopic ability, so that it was necessary to select the observers. As a result of his experiments, he announced that persons with normal eyes have a power of perception of depth of 10″.

In 1908, James published in the *Lancet* a description of an instrument which he called a distance stereoscope for measuring the angle of binocular parallax. He stated that he found it to correspond with the angle of visual acuity; that is, if each eye possessed an acuity of 1′ the angle of binocular parallax was 1′, although he furnished no data of his experiments.

In 1919, Howard adopted a slight modification of the James apparatus and made exhaustive tests of aviators at the Medical Research Laboratory at Mineola. His experiments showed that an individual with normal eyes of equal acuity and orthophoria should be able to distinguish a depth difference of 1.5*cm* at 6*m*. This is equivalent to a parallactic angle of 10.2″ for a pupillary distance of 60*mm*. He was dealing with picked men, many of whom had an abnormal visual acuity, and with such the depth difference perception was wonderfully acute.

Howard has also experimented with semaphores of 13*cm* diameter at a distance of 100*m*. This size was adopted as it represents the tangent of the visual angle of 1′ at 100*m*. He examined a number of the same men whom he had tested at 6*m* and found the binocular parallactic angle practically the same. The office test at 6*m* is therefore a trustworthy measurement of field stereopsis. It had heretofore been assumed by the writer that with his graded perspective charts (Series E) and an ordinary stereoscope, it was quite easy to determine the stereoscopic acuity, but the 6*m* test certainly allows of a more exact grading of the faculty.

So far as known, our knowledge of the binocular parallactic angle is limited to the findings of these three observers. It would therefore seem desirable to secure the coöperation of a large number of ophthalmologists to make these tests and publish their results. To do this the first essential is an inexpensive workable apparatus, and the second is the adoption of certain standards so that the results may be comparable.

James and Howard used a box in which rods of 1*cm* diameter could be moved antero-posteriorly, noting the smallest difference in distance which the subject could recognize. James used white rods in a black box and Howard black rods in a white box. The tests were made at a distance of 6*m*.

Both speak of the importance of securing equal and uniform illumination. The apparatus of Cohen (*Archives Ophthal.*, March, 1919) overcomes this objection, and would be quite inexpensive if there were sufficient demand to make them in quantity. Dr. Cohen very kindly loaned his apparatus to the writer, giving permission to make such changes as were found desirable. Figure 1 shows it so modified.

It consists of a sheet iron cylinder 30*cm* diameter and 40*cm* long, open at one end, mounted on a tripod. Originally it had four lights arranged quadrilaterally, but this has been simplified by reducing the number to two, in horizontal plane. The miniature lamps are on the ends of tubes which pierce the back of the cylinder and have an antero-posterior adjustment of about 20*cm*. The lights are covered with a white translucent glass and show evenly luminous circles of 28*mm* diameter. These were so arranged, that block letters or colored glass might be used in front of them. As now used, they are covered with black plates having openings of 1*cm*. One is fixed and the other plate is adjustable horizontally so as to make the separation equal to the subject's P. D. The whole affair is dead black, so that the observer sees only the two luminous disks. There is thus no possibility of utilizing any monocular parallax.

James says that the posterior stick should be .5*mm* larger than the anterior so that both would subtend the same visual angle, as otherwise the size of the retinal image might influence the judgment of the distance.

In order to make this difference exactly correct for varying distances, one of the lights was covered with an iris diaphragm, but in figuring out what this allowance should be, it was found that for a depth difference of 20*mm* the tangents of the visual angle vary only .03*mm*, for 200*mm*, .3*mm*. As the normal depth difference is 15 to 20*mm* it was evident that the size of the retinal image would not be appreciably influenced. The iris diaphragm was therefore discarded and two lights are of same diameter, 1*cm*. The ends of the tubes which project behind the cylinder are marked off in 5*mm* divisions.

The standard conditions suggested are as follows:

1. The apparatus shall be placed at 6*m* from observer.
2. The luminous disks shall be 1*cm* diameter.
3. Separation of disks equal to subject's P. D.

If these conditions are followed the results will be comparable with the experiments of James and Howard.

In using the instrument, the subject is asked to close his eyes and the depth difference arranged at 40 or 50*mm*. If on opening the eyes this difference is quickly recognized, the process is repeated with a smaller difference until the subject makes a mistake or is unable to see any difference. A few trials will suffice to determine a difference which is correctly

ILLUSTRATING DR. WELLS'S ARTICLE ON "ROUTINE OFFICE MEASUREMENT OF STEREOPSIS."

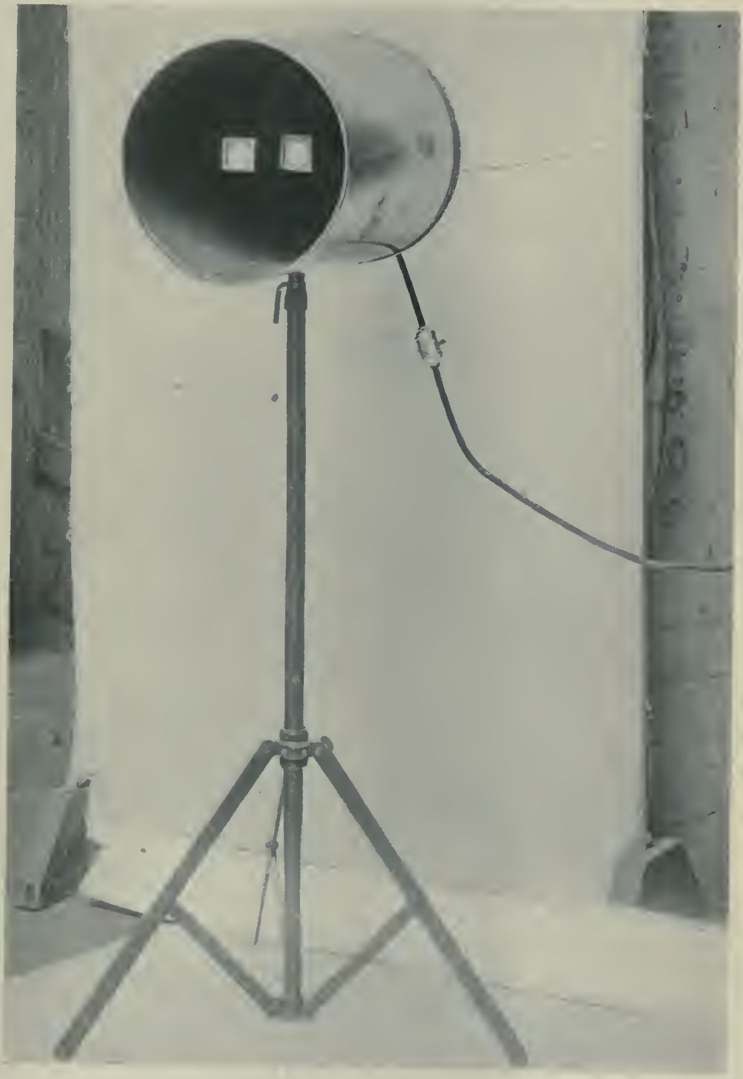

FIG. 1.

stated. Howard made twenty trials and considered that when answers were 75% correct, the subject's threshold had been determined. This seems to the writer a very unnecessary refinement, as a few trials suffice.

No one ever records visual acuity in terms of the visual angle, but as $\frac{6}{6}$ or 1. It is therefore evident that the record of *depth difference* at 6*m* will satisfy most of us. If, however, one wishes to know the parallactic angle it can be quickly determined by reference to the table which is abstracted from Howard's very elaborate figures. One decimal place is certainly sufficiently exact.

There are several methods of determining the angle for varying depth differences. The following figure is copied from James, the only change being the describing of an arc. This facilitates a simpler demonstration than that of James as follows:

Let A and B = the two luminous disks separated horizontally 60*mm* = to that of the nodal points L and R

Let AL = 6*m* = 6000*mm*

BR = 6180*mm;* that is B is 180*mm* farther from the observer than A

The right eye sees the two objects under the visual angle ARB

The left eye sees the two objects under the angle ALB

Draw AC parallel to LR

Then the triangle ALR = triangle CLR and parallactic angle = BLR − CLR = BLC

Since in right triangles tangent of an angle is the ratio of opposite side to adjacent side

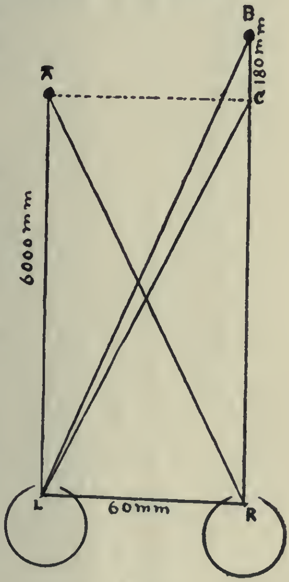

FIG. 2.

$$\text{Tang. BLR} = \frac{\text{BR}}{\text{LR}} = \frac{6180}{60} = 103 = \text{tang. of } 89^\circ\ 26'\ 40'' \text{ approximately}$$

$$\text{Tang. CLR} = \frac{\text{CR}}{\text{LR}} = \frac{6000}{60} = 100 = \text{tang. of } 89^\circ\ 25'\ 37'' \quad \text{"}$$

Therefore angle BLR − angle CLR = 89° 26′ 40″ − 89° 25′ 37″ = 1′ 3″ = parallactic angle, approximately.

ANTERO-POSTERIOR SEPARATION OF OBJECTS IN MM.

Pupillary Distance	5	10	15	20	25	30	40	50	60	90	120	150	180	210	240
58	1.6″	3.3″	4.9″	6.6″	8.2″	9.9″	13.2″	16.4″	19.7″	29.4″	39.0″	48.6″	58.0″	67.4″	76.6″
59	1.6″	3.3″	5.0″	6.7″	8.4″	10.0″	13.4″	16.7″	20.0″	29.9″	39.7″	49.4″	59.0″	68.5″	78.0′
60	1.7″	3.4″	5.1″	6.9″	8.6″	10.3″	13.7″	17.1″	20.5″	30.7″	40.7″	50.7″	60.5″	70.3″	79.9″
61	1.7″	3.4″	5.2″	6.9″	8.7″	10.4″	13.8″	17.3″	20.7″	30.9″	41.1″	51.1″	61.0″	70.9″	80.6″
62	1.7″	3.5″	5.3″	7.0″	8.8″	10.6″	14.1″	17.6″	21.1″	31.4″	41.7″	51.9″	62.0″	72.0″	81.9″
63	1.8″	3.6″	5.4″	7.1″	8.9″	10.7″	14.3″	17.8″	21.4″	32.0″	42.4″	52.8″	63.0″	73.2″	83.2″
64	1.8″	3.6″	5.4″	7.3″	9.1″	10.9″	14.5″	18.1″	21.7″	32.5″	43.1″	53.6″	64.0″	74.3″	84.6″
65	1.8″	3.7″	5.5″	7.4″	9.2″	11.1″	14.8″	18.4″	22.1″	33.0″	43.8″	54.4″	65.0″	75.5″	85.9″
66	1.8″	3.7″	5.6″	7.5″	9.4″	11.2″	15.0″	18.7″	22.4″	33.5″	44.4″	55.3″	66.0″	76.7″	87.2″
67	1.9″	3.8″	5.7″	7.6″	9.5″	11.4″	15.2″	19.0″	22.8″	34.0″	45.1″	56.1″	67.0″	77.8″	88.5″
68	1.9″	3.8″	5.8″	7.7″	9.6″	11.6″	15.4″	19.3″	23.1″	34.5″	45.8″	57.0″	68.0″	79.0″	89.8″

Table of B inocular Parallactic Angle.
Nearer object 6*m*
Size of object 1*cm*
Separation of object = P. D.

Howard's demonstration and tables which came to hand later, have been worked out by using the radian as a unit of measure and are evidence of a tremendous amount of patience. He determined his values to five significant figures, which is certainly a needless refinement and probably beyond the limits of accuracy of the experiment.

In presenting this very simple method of measuring stereopsis it is hoped that a number of ophthalmologists will coöperate by making it a part of the routine examination and publishing their results in terms of depth difference. Five minutes ought to suffice, and perhaps one minute more for recording the corresponding binocular parallactic angle. It ought certainly to claim the attention of those of us who are interested in stereoscopic fusion training, as James says he has found the apparatus of much value for this purpose. The writer is deeply indebted to Captain Howard for free use of his unpublished manuscripts.

THE MOTOR MUSCLES OF THE EYE

THEIR PATHOLOGY IN ASTHENOPIA

By E. H. HAZEN, M.D.

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(*With one illustration on Text-Plate VII.*)

THE purpose of this article is to demonstrate the fact that the writer in treating the muscles for asthenopia has, unconsciously, discovered the pathological causes of asthenopia in the extrinsic muscles, and probably also in the ciliary. The course which has been taken, and arguments for the conclusions at which he has arrived, are here described.

It is now over fifty years since Professor Donders published his work *Anomalies of Accommodation and Refraction of the Eye*, which time covers, just about, the term of the writer's practice of ophthalmology.

Donders revolutionized ophthalmology. It was so great a boon to the world, and so filled a great gap in the practice, that even to-day there are but few who have advanced beyond his principles. His 'ology of asthenopia encompassed all the symptoms that we have since named under "Eyestrain," and his remedy was a lens. The brilliant success attending so many cases of asthenopia has given such confidence to an army of glass fitters, that it has become very easy to induce the people to wear a saddle on the nose for infinitesimal errors.

The mechanical perfection of grinding the glasses and the mounting of them in attractive frames have given optometric science in America a world reputation.

In the adolescent period of scientific medicine, the expressions describing symptoms are proverbially more or less vague. The symptoms given by Donders in his work were, "morbid condition of the eyes," "dimness of vision," "affection of the retina from excessive employment," "disposition to fatigue," "slowly adjusting sight." However he says "the phenomena of asthenopia proceed from nothing else than from fatigue of the muscular system of accommodation"—which is the keynote of his system.

The more intricate apparatus of the motor system of the eye was not considered by him, and has been since sadly neglected, although I find that more than half of the cases of eyestrain are from anomalies of the extrinsic muscles. The glassing of so many, old and young, is no proof of such prevalence of errors of refraction as a cause, as this would be interpreted. With refractive errors of less than one diopter spherical, or a half diopter cylinder, when the axis of that cylinder is at vertical or horizontal axis and vision $\frac{20}{20}$, glasses are entirely unnecessary in the young subject, and sometimes injurious, *when the motor apparatus is first put in order.*

Bohne, before Donders, attributed these symptoms to a weakness of the motor nerves of the eye, but his idea was submerged in the attention to ametropia.

Hyperæmia of the retina with sometimes ametropia and amblyopia was recognized quite early, but all of these symptoms were expected to be relieved in correcting the "hypermetropic structure of the eyes," or was passed over as something that could not be reached.

The literature of ophthalmology for the next two decades has been overburdened with theories and devices for the discovery of anomalies of accommodation and muscles, and for the conquering of them, and specialists of the eye became divided into two factions on this subject; on the one was the doctrine that the cause lay in ametropia; on the second that "imbalance" of the muscle system was a frequent cause. The first sought the glass to correct, and the second is supplemented by tenotomy.

The theories of Donders went almost unchallenged until Dr. Dyer at the second annual meeting of the American Ophthalmological Society in New York in 1865 reported several cases of severe asthenopia who had no hypermetropia, but with absolute pain, and who had ceased to use their eyes, and some sat continually in the dark.

A number of the oculists present had had the same experience in their practice, and testified in like manner. At this meeting, Dr. Noyes used the expression of von Graefe: "Insufficiency" with "extreme irritability of the retina" which gave some indication as to the cause. Dr. Dyer, in explanation of the condition of these cases, said "that there is a want, a discrepancy of the relative accommodation, or a discrepancy between the power of the internal recti and the ciliary muscle." His idea was that "if the hypermetrope had a glass given him, of course the range is altered." He "changed the relation of accommodation to the angle of convergence by glasses," exercising at the near point at stated periods. Thus was born to the profession in America, gymnastic treatment of the ocular muscles, though crude in adaptation.

Between this time and the session of the International Ophthalmological Congress, which met in New York in 1876, Dr. Noyes did much in making differentiation between accommodation and muscular asthenopia, discovering many symptoms, mostly reflex. The definition of asthenopia from that time was gradually expanded to that of any symptom of pain or discomfort in the physical system, wherever found, which could be traced to the eye as a cause.

Dr. Noyes's paper at the International Ophthalmological Congress in 1876 on *Deductions Respecting Asthenopia* says that von Graefe admits that the hyperæsthesia of the retina is associated with a certain degree of accommodative and muscular disturbance but acts an inferior part of the mischief and "offers no outlet for successful treatment," that he "assigned the primary lesion to undue sensibility of the retina, or to neuralgia of the nerves of sensation." Dr. Noyes regards this diagnosis as "one which too often gives cover for imperfect examination—either through haste or neglect, or incompetency of the oculist," and says further, "I am not sure but that we will yet discover some hitherto unknown cause for the exalted irritability in a constitutional dyscrasia or some abuse of the eyes. . . ."

During the decades about the last years of the nineteenth century, and the beginning of the twentieth, the muscular apparatus grew in importance and eyestrain was found due to the muscular system in a high percentage. There grew apace among the tenotomists the terms "insufficiency," "imbalance," "tenotomy," "torsion," and other hypothetical phrases, and these cases were almost universally given over to the correction by surgical interference, or by the artificial means of bending the rays of light to the eye pulled out of line by the recalcitrant muscle or muscles, which allowed them to proceed on their mischievous wayward course, and then were followed by a stronger prism, etc. These processes in the new light are seen to be makeshifts, substitutions, and apologies.

The common practice of using hand prisms and presenting a prism, say 5°, then laying it down and picking up another of greater or less denomination, is very awkward, unscientific, and ineffective, because: 1st, The strength of the prism is generally far greater than the muscle is able to overcome at a "jump." To find the succession of the proper denomination, it is necessary to pass through degrees the muscle overcomes easily and to add to it intervals that are adapted to that particular muscle. 2d, The lens thus handled by hand is not apt to be in true axis. 3d, When laid down as above described, if it has been overcome, the eyes have to "jump" the full amount of the next lens instead of a difference between, as in a battery of lenses. 4th, The lenses used in this way, no doubt, sometimes touch the eyebrows and the eyelashes. Soon the patient becomes tired and nervous before much, if anything, is accomplished. The most of these cases have a dread of motion and cannot endure the manipulation before them. We can see that orthoptic treatment has not been properly tried. There are a few cases that improve under it, but the majority thus treated do not respond. I sometimes prescribe a set of hand prisms for exercise to keep them from relapsing.

I have been assiduously at work on this problem, commencing early in the '90s, and have from time to time published papers and a book entitled *New Findings in Ophthalmology and Otology*. I examined the eyes of five hundred pupils in the schools of Des Moines, Iowa, through which and with my private practice and the clinics of the Medical College of Drake University I became acquainted with the character of these muscles and learned to handle them. I soon realized the extensive field of the ophthalmologist which has not yet been properly worked.

The results of treating asthenopia by gymnastics was more satisfactory than my sanguine expectations imagined. It encompassed many symptoms already enumerated as accommodative asthenopia, and others of difficult differentiation, and included many more remote and obscure ones, and trespassed on syndromes thought to belong exclusively to other specialties.

I will not here take space to compare the differences in results between the refraction method in dealing with asthenopia, and that of gymnastics of the muscles. I have written much already on that point. On my more intimate acquaintance with these muscles, I gradually became convinced of the fact (or at least of the working principle) that all of the muscles were alike as to function in maintaining equilibrium at rest, and harmony in effort; they differ in construction, or physical ability, for the differences demanded of them in excursion: some much more elastic, compared with the stiffness in others; the lateral, for instance, made perhaps three times the excursion of the vertical; the verticals respond more slowly to discipline than the laterals, and are most apt to be found receding from the amount gained from day to day, but this is not difference enough to abandon the idea that the verticals cannot be regarded under the general principles of orthoptic treatment. Some abnormal conditions show spasmodic action as in squint, but it is yet to be proved that this phenomenon in strabismus convergens has not the same general cause (in addition to excessive accommodation) that I here attribute in general to asthenopia.

This method of treatment is approaching the subject by the path of *function* on which I have been able to find relief in so high a percentage of cases, rather than by the mechanical-repair-method, as the one worked in the "imbalance" theory.

The imbalance conception of anomalies does not recognize asthenopia in the (at least) 50% of cases that have no imbalance of any consequence. The worst cases I have treated were those with neither imbalance or errors of refraction, that amount to anything. There are symptoms in thousands of asthenopic cases that are presented to the practitioner and are difficult for the patient to describe, and for which the cause has been sought in every organ of the body, but which effort has been, at last, thrown into the waste basket with the declaration that "there is nothing the matter with you," and the patient given a moral lecture on self-control.

Much labor has been spent to find a "latent heterophoria." This is a myth. Refraction is more easily and more certainly made when the field is clear of the causes of spasmodic action of the muscles.

In the literature of asthenopia some of our authors have been able to depict symptoms with graphic psychological clearness, but stopped short of ætiological accuracy and consigned the indications to an unknown and unfound error of refraction, while others believed the undiscovered cause to be in the mysterious motor apparatus; but many of the strange symptoms and their effects on the mental and moral character, they attributed to dyscrasia, corrupted training, or mental turpitude.

After finding this treatment relieved many persons who had appealed to men of the best reputation in the country, and who changed glasses, or either prescribed for diseases of remote organs or told the patients there was nothing the matter with them, I believe that proper attention to this apparatus will give more satisfaction in removing asthenopic symptoms than the fitting of glasses, now so exclusively practiced.

It is hardly fair for physicians to assume the attitude of an infallible sage with the "I am" argument towards patients who are not insane and willing to consult ten or fifteen of them and pay their fees, to "make rather light of their troubles" or pronounce them as having "too vivid an imagination and fretful under their disabilities" and to give them moral lectures. I have learned from seeing so many of these "rounders" that we as symptomatologists should be in a more receptive attitude towards the recitation of the strange symptoms of those who seek relief; a wider compass and more zones of syndromes are yet to be recognized as relating to the organ of vision than is generally believed; the many unaccountable desperations of individuals have more of a physical cause than is generally believed.

I would not be understood as decrying the correction of ametropia, when the degree of error is of importance. I only condemn the exaggeration of this remedy, by putting on glasses of so weak a denomination that it becomes ridiculous and even a direct fraud, and repeating it with slight changes, passing over without thought a closely associated function where there is a possibility of better success.

Then again, the majority of cases that require glasses, need also the treatment of the muscles of convergence, and if I am not mistaken with regard to my pathology of asthenopia, this exercise would give better success to glass fitting.

Starting, as I did, from the conviction that these motor muscles could not perform their work because of their weakness, I arranged the means to give them muscular discipline or gymnastics, by prisms with gradually increasing power, in batteries. The training of the muscles of the eyes, was a new field and there were no instructions to be had, so the adventures in the process were numerous and mistakes were inevitable.

I constructed an instrument in connection with these batteries, I named *kratometer*, on principles I regarded necessary to call these muscles into action, believing from general principles, it was not rest they needed, as had been advocated, to cure muscular difficulties, but work under proper restrictions and care. In recognition of the difference in character of these muscles, I made the intervals in the batteries of lenses to correspond. To be more lucid, I may put it in this way; there were 50° units from parallelism on the convergence act, and sometimes 30 or 40 on the other side from parallelism. The interval between the prisms for these was one degree. The external recti, to get to standard, there were 16 units of a half degree. With the verticals there were 12 units to get of one-quarter of a degree.

To present these batteries to the fusion sense to induce action of the muscles, they were run in a groove with the axes of the lenses with the pull of the muscle, and on a plane with the face of the patient, gradually increasing the strength and acting smoothly until reaching the inability of the eyes to fuse the object (which is a light). Then the battery is withdrawn, and the patient is allowed to rest for a few seconds before another lift is attempted. The appealing to the muscles by small intervals, with regular rhythm is especially efficacious, and particu-

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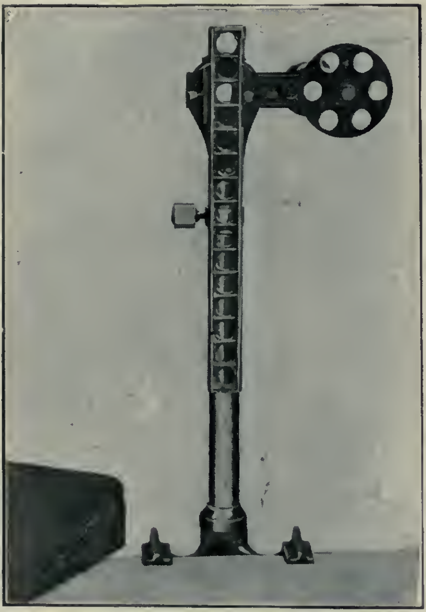
ILLUSTRATING DR. HAZEN'S ARTICLE ON "THE MOTOR MUSCLES OF THE EYE."



larly toward the end of the lift to break up the inertia from long idleness.

By this process I have been able to discipline one set of muscles as effectively as another: that is I could get a unit with the adapted lenses on the vertical as well as on the laterals, and so discipline the verticals and correct the heterophoria in either.

I was very much surprised at the results in relieving asthenopia, especially in cases that had been glassed a number of times before, and I could not reconcile the quickness of the relief, and its permanency, to the idea of repair of the muscle structure or the nervous weakness.

I found several cases, also, that were relieved of serious symptoms in persons who had no idea that they had any defect of the eyes.

I soon realized that this instrument was a powerful and effective one on the muscles, and required great judgment and care in its use. By it one can break down the lifting power, more quickly than by over use of the eyes in vocations. At first I exercised twice a day, latterly once a day, making but five to seven lifts at a sitting.

It is generally conceded that the point of rest of the straight muscles of the eyes, is at parallelism, at least when the eyes are open, and if there is no obstruction, or no abnormal nerve force interfering, the sense of fusion will always bring the axes of the eyes to this law of balance or rest, but when found out of balance, it must be from this interference of the law. This *im*balance, then, is a symptom and not a disease. The inquiry of Dr. Dyer is a very natural one: "Why is it that accommodation, convergence, and torsion did not bear their proper relation to each other, and Why is there obstruction?"

In bringing these muscles to their standard of strength by my instrument, I have found as a rule, that the imbalances, found at the beginning, were corrected. Sometimes, however, there has been a slight 'phoria at the finish, but as the treatment has given freedom of action of these muscles, the small imbalance would soon be corrected by the fusion law, for nature is economical enough to bring the resting point to the starting point for action. This expectation I have found to be the fact in many that I have had the opportunity to test afterward. But the imbalance left is not felt, for the muscle is now able to overcome it with ease.

Associated with most all varieties of muscular asthenopia, and many of pure accommodative asthenopia (if there be such) there is congestion of the vascular system: a chronic hyperæmia. Sometimes only the vessels of the outer coat, conjunctiva, which often gives a sunken and lifeless, soggy appearance, sometimes dry and sometimes watering. In other cases the congestion gives a pink color to the lids, showing a congestion of cartilage and surrounding parts, tending to styes or blepharitis marginalis. The congestion of the retina is often found, termed retinal hyperæmia or hyperæsthesia, with intolerance of light. Many cases of this nature wear colored glasses, and there are all kinds of theories about the ray tints. Black glasses that shut off much of the light and dull the sensitive periphery of the retina, upon which the side objects call for movement of the balls to fix on another point, and in these cases there is a dread of motion; with some it is the bane of their existence. They soon become stiff in their manners. In advanced cases there is deterioration of vision, often progressive exophoria. The eyeballs in the latter form are quite white and healthy in appearance.

These subdivisions I have made in the different phases of anomalies, are in consonance with the oculist's experience in treating inflammatory diseases of the eyes, viz., that one layer can be affected without implication of another. The anatomical distribution of the vessels explain it. When the eyestrain has been of long duration, the congestion is apparently "deeper seated" and requires, accordingly, more treatment.

The question whether the ciliary muscle is not alike affected as in other kinds of asthenopia with the same pathological condition, is open for experience, and that pathologically there is no difference only in degree.

The proposition so laboriously worked on, that some of the muscles are too long or too short (not well matched), or are inserted too far back, or too far forward in the capsule of Tenon (misfit), becomes a myth under this study. Muscles have a wonderful adaptation, if the hygienic conditions are right.

We come now to the question of pathology of eyestrain. In all the discussions of the probable ætiology of eyestrain, the idea of a septic deposit as a cause of asthenopia, has not been advanced, but I believe it to be the proper doctrine. That this organ with its muscular organism, and so constantly at work should sometimes be a subject of unsanitarian laws, is a reasonable conjecture. The ophthalmoscope reveals a condition of the inner membrane that has not been interpreted, or a means to get rid of if found, and is the condition observed in many muscular anomalies. We most always find congestion of the retina; with this hyperæmia every oculist is familiar. In the stages of degeneration, leaving out those of hemorrhage, toxin, uræmic, diabetic, and reflex, we have a gradual increasing amblyopia, which progresses to the condition of perception of light only. Intolerance of light is often a symptom at first. Some authors describe hyperæsthesia of the retina, but after refracting, prescribing rest, and putting on colored glasses, there is nothing further done unless neuro-retinitis or some other actual disease that might be suspected or feared is found.

The application of glasses, though a good one, and is all that is needed with some, is a mechanical proposition to relieve "fatigue," and nerve irritation, and it materially lessens labor in focusing, but it does not add anything hygienic. It is doubtful in my mind whether it ever cured asthenopia; there are thousands who have laid their glasses off, finding no relief in the experiment.

The quick relief of asthenopia by my gymnastics given to strengthen the muscles and restore them to use, has, at the same time, removed the congestion and amblyopia, and often made me wonder what I had found. Cases that had been suffering for years, were relieved with less than ten treatments; car-sickness, sickheadaches, cases of intolerance of light, with from 25 to 35 treatments; and cases of exophoria or exotropia, to the extent of 25° or more, with an amblyopia that reduced vision to mere perception of light, were brought to parallelism, and to convergence of 40° in less than one month's treatment, with vision for reading common print by the unused eye.

This result has been attained not only in giving the muscles strength, but I believe by *pumping out the sepsis from the capillaries and tissues, the products of hyperæmia and inflammation,* *and thus giving them free action*, and not as was at first thought, that it was giving the muscle more nerve power. I believe this clogging up of the vascular system with this debris, is the cause of the pain, both in muscular and in accommodative asthenopia.

I always treat the extrinsic muscles at the far point, and the accommodation has improved by several dioptries, even at the age when presbyopia first appears.

This hygienic improvement of the eyes upon this treatment explains its character of permanency, for not more than one in twenty relapse in two years. To arrive at a means by which the general healthfulness of the eyes can be brought about, must certainly be appreciated.

Of the weakness of the muscle and the sanitary condition named, which is the primary and which is the secondary, is left for the pathologist to determine, but if my conclusions are correct in this essay, the muscular apparatus outranks in importance refraction, and should be the first administered in the cure of asthenopia.

The office of these ocular muscles is not yet sufficiently appreciated. They are the quickest muscles of the body and are built for speed (fibers end to end—Maddox). In health the two eyes act as one and act together in establishing our consciousness of orientation, that is, we are able by it, to measure distance, relation of objects to each other, and to ourselves and hereby give individual and personal assurance. In health this is done instantaneously. In crossing a crowded thoroughfare the fixing of the eyes is changed, perhaps a thousand times. The side objects, especially if moving, call attention by the very sensitive periphery of the retina, and the eyes fix from side to side by bringing the fovea centralis of the retina into line quicker than a wink, and that without winking, the focusing function accompanying the fixing when required, and so safety is assured and the individual is able to "keep his head." If there is the slightest separation of the images of the two eyes there is blurring and confusion.

The new engineering profession of aviation, requires this faculty of quick fusing, and must be the most important requisite in successful flying.

In this kratometer system we have the artificial means of testing this faculty, by throwing the image of the object that has already been fixed on the retina, to the periphery, by the use of its batteries of prisms. The same means can restore a defective fixation.

CONCERNING THE NATURE OF TRACHOMA; TOGETHER WITH A CONTRIBUTION TO THE NORMAL HISTOLOGY OF THE CONJUNCTIVA.

By Dr. KAZUO HIWATARI, Kioto, Japan.

(*With five illustrations on Text-Plate VIII.*)

(From the Acta Scholæ Medicinalis Universitatis Imperialis in Kioto, Japan.)

I. INTRODUCTION.

WE do not doubt to-day that trachoma is an independent infectious disease, although its specific agent has not yet been discovered. Aside from this, much remains to be explained about trachoma, and even the question as to what constitutes its most important pathological change has not yet been decided. The answer to this question is of importance both to the practitioner who deals daily with patients, and to the scientist who seeks to solve the problem of ætiology. The differences of interpretation, such as now exist between Lindner (1) and Loehlein (2), can, in my opinion, be reconciled only in this way.

Junius (3) believes the characteristic change to be the development of the granule in the adenoid layer of the conjunctiva, and that the other changes, though important from the practical point of view, are of secondary signification as regards the nature of the disease. His idea is that the eruption of granules is interwoven with the presence of adenoid tissue, and that as this disappears the trachoma is cured by transformation into cicatricial tissue.

Saemisch (4) thinks the essential feature to be a diffuse disease of the adenoid tissue which leads inevitably to the formation of cicatricial tissue, the formation of follicles to be nothing more than an accompanying symptom, and the importance of the granule to be slight so far as the pathology of trachoma is concerned.

W. and M. Goldzieher (5) thus state their conclusion: "Regarded from the standpoint of pathological anatomy trachoma is a disease caused by a specific agent as yet unknown and located in the vascular layer of the conjunctiva. The virus attacks first the vessel walls, the adventitial cells of which react to the specific agent with a lively production of lymphocytes, which group themselves into inflammatory granules. After dialysis of the specific agent follows a destruction of the perivascular proliferation, and parallel with it a new formation of connective tissue from the fibroblasts of the vessel walls that is synonymous with the end of the trachoma process, with its healing in the anatomical sense."

Ichikawa (6) believes that the histological picture found in both pannus and the scleral and palpebral conjunctiva, plasma cells, young connective tissue cells, and blood vessels is alone characteristic of trachoma. He excludes the follicle from among the characteristic changes because it is confined to the palpebral conjunctiva; to him it is only an anatomical impurity. He considers trachoma to be a diffuse granular inflammation of the conjunctiva which can, under certain circumstances, press forward into the cornea by way of a continuous propagation and so bring about trachomatous pannus.

Mutermilch (7) does not believe the presence of a specific agent necessary and propounds the theory that trachoma is one of the common chronic inflammations of mucous membranes which are covered with cylindrical epithelium and have adenoid conditions in their submucosa, having much in common with gonorrheal urethritis, uterine psoriasis, and atrophic rhinitis. He holds that there is no specific agent, that the various bacteria which cause acute conjunctivitis can also excite trachoma, that follicles and pannus are only accompanying symptoms which have no significance as regards the ætiology, course, and result of the disease.

According to Pascheff (8, 9) trachoma is not a simple inflammation, but a confluent, lymphadenoid, follicular hyperplasia of the conjunctiva and cornea which originates from the special basis of the general lymphatic constitution of the body, as is now generally accepted to be the case with the lymphadenoid vegetation of the pharynx and nasopharynx.

Axenfeld (10) says that Ichikawa was incorrect in thinking that follicles do not occur in pannus. According to him follicles appear in pannus when the inflamed corneal tissue is sufficiently loosened up, and the process of trachoma alone is able to produce follicles.

In this brief collation it is striking how widely the opinions of the various authors differ. This difference of opinion may be ascribed, first, to the fact that hitherto authors have unanimously confined their studies to the conditions in the conjunctiva, without taking into account the general findings of pathological anatomy in other mucous membranes, and, second, that the normal histology of the conjunctiva has not as yet been sufficiently cleared up. The questions still remain whether the follicle is a normal constituent of the conjunctiva, what variations normally occur in the conjunctiva, and how the subepithelial layer is constituted. I will now present the results of my own investigations.

2. SHOULD THE TRACHOMA GRANULE BE CONSIDERED A TRUE LYMPH NODULE?

Most students of trachoma, like Bendz (11), Raehlmann (12), Villard (13), Pick (14), Addario (15), Greef (16), Junius (*l. c*), Saemisch (*l. c.*), agree that the trachoma granule does not differ in its histological structure from a lymphatic nodule, though there are occasional students, like B. Jacobson (17) and W. and M. Goldzieher (*l. c.*), who deny this and consider the trachoma granule to be a sort of granuloma. My own histological examination confirms the findings of Saemisch and others, so a lengthy description may be omitted. One thing alone seems to me quite new and not without importance to the understanding of the trachoma granule, the migration of lymphocytes through the epithelial layer where beaker cells, as a rule, are wanting (Fig. 1). This phenomenon is constantly present in all stages of the development of the trachoma granule. The epithelial layer is thereby more or less permeated with lymphocytes and appears to be somewhat loosened up, the basal cells are arranged rather more irregularly than normal, and the superjacent cells are more or less distinctly flattened. The extent of the epithelial layer showing this phenomenon of migration varies according to the size of the lymph nodule; with little follicles it is demonstrable in only a small series of sections and can very easily be overlooked. What is the meaning of this condition? Axenfeld (18) has seen it and illustrated it beautifully, but he took it to be a simple inflammatory infiltration of lymphocytes. I regard it as the imprint of one of the physiological functions of the trachoma granule, just as Stoehr (19, 20) did many years ago with the otherwise physiological lymph nodule. In favor of this theory is the fact that the number of migrated lymphocytes depends in no way on the intensity of the inflammatory symptoms, and the fact that the migration can always be demonstrated in fresh granules consisting of only a few cells. I believe that this finding supports the theory of the lymph follicle nature of the trachoma granule.

A word concerning the nature of the large mononucleated cells in the follicles which, under the names of phagocytes (Villard) and corpuscle cells (Leber), have been interpreted variously, both as to their histogenesis and as to their importance. Thanks to the vital stain we know to-day that the sessile reticulum and endothelial cells of the hæmatopoietic tissues and the star cells of the liver, the reticulo-endothelial histioblasts of Kiyono (21), under certain circumstances gradually become round and may become transformed by cell division into the mobile macrophages to which Kiyono has given the name of histiocytes. These histioblasts and histiocytes may take into themselves as phagocytes various elements from their surroundings. The histiocytes show a positive plasma reaction with the Unna-Pappenheim stain. There is now no doubt that the hitherto puzzling mononucleated cells of the lymph nodules are both morphologically and functionally nothing else than the histiocytes of Kiyono. They are a reaction product in the trachoma granule originating from the reticulum cells of the lymph nodule. Professor Kiyono was so kind as to look over my histological preparations, for which I offer him my best thanks. The cells held to be plasma cells by W. and M. Goldzieher (*l. c.*) in the commencing granule are in my opinion not true plasma cells, but the same formations that have been demonstrated by Weidenreich (22) in the lymph nodules of the spleen and lymphatic glands and named lymphoblasts. Perhaps the common positive plasma reaction led the first named authors to their conclusion, but plasma cells and histiocytes differ in the structure of their nuclei.

3. IS THE LYMPH NODULE A NORMAL CONSTITUENT OF THE CONJUNCTIVA?

This question has received widely different answers. Krause (23), Henle (24), Schmidt (25), Kleinschmidt (26), Baumgarten (27), Schwalbe (28), and others regard the lymph nodule as a normal constituent. Stoehr (29) defended this view in 1885. H. Virchow (30) advocated the same in Saemisch's *Handbuch*, as he had demonstrated a lymph nodule in the supposedly quite normal conjunctiva of a man twenty-three years old who had been executed. On the other hand Waldeyer (31), Stromeyer (32), Blumberg (33), Wolfring (34), Sattler (35), Reich (36), and others deny its normal existence in the human conjunctiva.

When the names of these authors are closely scanned it appears that those who held the first view were for the most part anatomists, while the second group was composed mainly of clinicians. The difference of opinion therefore is not due to the different materials handled.

Formerly I held the former opinion, but when I undertook to confirm it by a histological examination of the zone of plateaus and grooves (H. Virchow) and of the conjunctival fornix, macroscopically free from follicles, from several healthy persons, I could find no follicles in spite of a careful examination of series of sections. I thought this was because the follicles were not just where I looked for them. But it happened that I examined histologically a piece of conjunctiva from the lower fornix of a girl thirteen years old, which had a single minute bleb as clear as water. This bleb consisted of a very small quantity of lymphocytes and had in its middle no germ center (Fig. 2). This convinced me there are in the conjunctiva no lymph nodules not macroscopically visible. A conjunctiva in which no follicles are macroscopically visible, met with not

EXPLANATION OF THE ILLUSTRATIONS.

Fig. 1. Section from the upper transition fold of a trachomatous conjunctiva. About the middle is a young follicle with an indistinct margin. The epithelial layer covering it abounds with migrated lymphocytes. Hæmatoxylin (Boehmer)-eosin stain. Leitz, ocul. iii. and obj. 3.

Fig. 2. A very small lymph follicle, which appeared clinically as a minute bleb as clear as water, from the lower transition fold of a girl. Stain and enlargement the same as in Fig. 1.

Fig. 3. Section from the upper transition fold of a normal conjunctiva. L—lymphocytes, H—histiocytes, P—plasma cells, B—connective tissue cells. Stain as before. Zeiss compens., ocul. iv., oil immersion obj. $\frac{1}{12}$.

Fig. 4. Section from the zone of plateaus and grooves of a trachomatous tarsal conjunctiva of the upper lid. At A is a commencing follicle formation, at B a profuse proliferation of fibroblasts. The fibroblasts have pale nuclei. Stain as before. Zeiss compens., ocul. iv., obj. D.

Fig. 5. Section from the corneal limbus of a normal conjunctiva. In the right half the epithelial layer consists of laminated cylindrical epithelium. Stain as before. Leitz, ocul., iii., obj. 3.

Illustrating Dr. Hiwatari's Article on "The Nature of Trachoma."

Fig. 1.

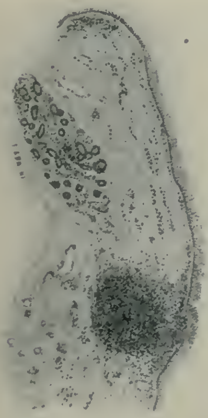


Fig. 2.

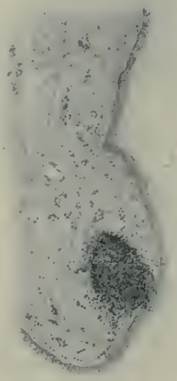
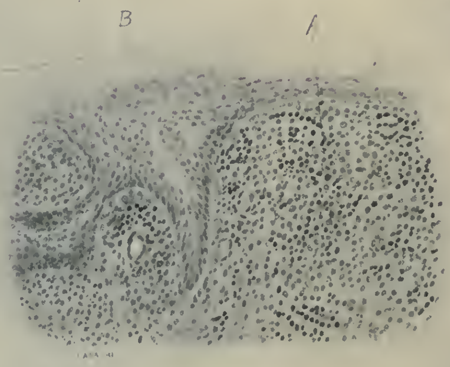


Fig. 4.



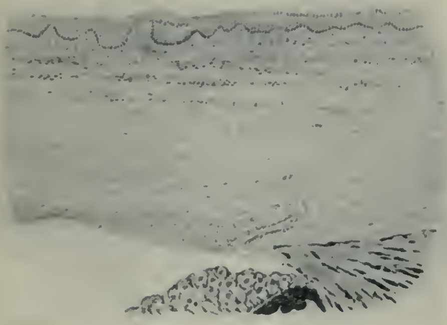


Fig. 5.

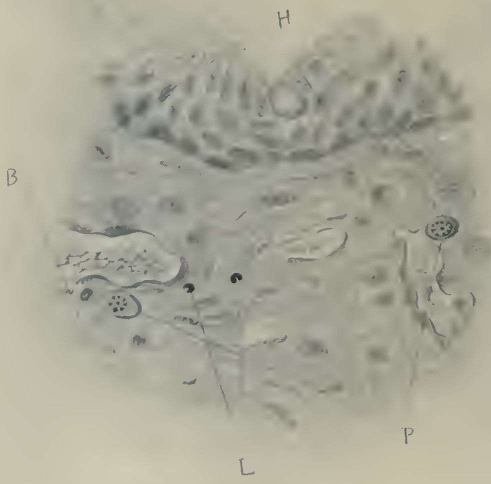


Fig. 3.

rarely in children, must be considered as truly free from follicles. A perfectly transparent conjunctiva through which the subjacent vessels and Meibomian glands are well visible, which also has a smooth surface, is therefore to be regarded as the normal, ideal condition of the membrane.

I now feel certain that the lymph nodule is not a normal constituent of the conjunctiva. I believe it to be a reaction product to the various sources of irritation that affect the conjunctiva during life. Its presence always indicates that at some time some sort of irritation has occasioned a formation of follicles. It is difficult to speak positively concerning the fate of any single nodule, but it is quite probable that it disappears spontaneously after the discontinuance of the irritation.

4. UNDER WHAT CONDITIONS DO LYMPH NODULES APPEAR IN THE CONJUNCTIVA?

Before entering upon this question, the fact must be presupposed as generally accepted that the lymph nodule in the normal mucous membrane, as in the gastrointestinal tract, exists as a protective apparatus, and that under certain circumstances it may react with hyperplasia to irritations there. General pathology has shown us that, when induced by irritation, lymph nodules can appear more or less abundantly in mucous membranes in which normally they are few or absent, as not infrequently in the bladder.

As the conjunctiva can form no exception in the pathology of the mucous membranes, we must consider the development of lymph nodules there to be quite analogous to what has been shown to take place in general pathology. The theory advanced by Raehlmann (*l. c.*), Greef (*l. c.*), Axenfeld (39), and Saemisch (40), that the formation of follicles in the conjunctiva is a reaction product due to external irritation, is not to be controverted. Still this simple explanation does not suffice; conditions in the conjunctiva are complicated. In the first place, atropine catarrh occurs only in occasional persons and one has to assume the presence of a second factor, a general predisposition of the individual. Pascheff (*l. c.*), as already mentioned, expressed a similar opinion in his explanation of the trachoma follicle. The specific irritation suggested by Greef (*l. c.*) seems to me very questionable. In the second place, the formation of follicles takes place by no means uniformly throughout the conjunctiva; it appears by preference in the fornix and on the palpebral conjunctiva, while it is usually absent on the bulbar portion of the membrane and in pannus. To explain this it is necessary to assume the presence of a local predisposition.

It is hard to say upon what this general and local predisposition may depend, but certainly age plays no small part in the former. This is shown by the clinical experience that follicles are few in infants and in old age, while plentiful in childhood and youth. Whether the general lymphatic constitution of the body is of importance, as assumed by Pascheff (*l. c.*), remains undecided. As regards the local tissue predisposition, this has frequently been ascribed to the so-called adenoid nature of the subepithelial tissue, when it is assumed that the conjunctiva of the fornix and lids produce follicles abundantly because of an adenoid subepithelial layer while that of the globe and limbus does not because in them this layer is absent.

The first thing to be decided is whether the subepithelial layer of the conjunctiva of the fornix and lids is truly adenoid. The first author to assert it to be was His (cited by Zehender, 41), whose view soon found general approval so that it is now found in almost all textbooks on ophthalmology. H. Virchow (*l. c.*) rejected the theory completely, and this induced me to renew my study of the normal human conjunctiva.

The ground on which Virchow based his opinion was the fact that plasma cells were more numerous than lymphocytes in the subepithelial layer of the normal conjunctiva. My investigations confirmed this finding, but I also found that Virchow's plasma cells were not uniform, that they were divisible into two quite different kinds of cells, the histiocytes of Kiyono (klasmocytes of Ranvier), and the true plasma cells of Marschalko. The properties which these two kinds of cells have in common are abundance of protoplasm, excentric position of the nucleus, and positive plasma reaction to the Unna-Pappenheim stain. They can be clearly differentiated by the minute structure of the nuclei, as the plasma cells show a typical spokelike arrangement of the chromatin framework, while the histiocytes have pale, roundish or somewhat arched nuclei (Fig. 3), but the most essential difference is that the histiocytes take up the coloring matter of the vital stain into their bodies, while plasma cells do not.

The presence of these histiocytes in the animal conjunctiva has been experimentally demonstrated by Rados (42), and by Schnaudigel (43), and it is hardly doubtful that they are present in the human conjunctiva also, although this has not yet been proved by the staining method. I believe that the greater part of the plasma cells in the conjunctiva described by Stoehr in his textbook of histology are identical with the histiocytes of Kiyono. I found these histiocytes preëminently in the neighborhood of the blood vessels, while the typical plasma cells were scattered sparsely here and there in the subepithelial layer.

The theory that the subepithelial layer of the conjunctiva fornicis et palpebrarum is adenoid can therefore no longer be held to be correct. Both it and the idea that the formation of follicles is connected with an adenoid nature of this layer must, in my opinion, be abandoned in the future.

This is not meant to imply that the nature of the subepithelial layer of no import in the formation of follicles in the conjunctiva. It is a settled fact that this formation takes place by preference in the conjunctiva fornicis et palpebrarum. Although the designation adenoid was not fortunate, yet it must be admitted that the conjunctiva of the fornix and of the lids far exceeds that of the globe in the abundance of cells in the subepithelial layer, and that the importance of this difference in the number of cells is not to be underestimated in the development of follicles.

The second morphological difference between the conjunctiva of the fornix and lids on the one hand and that of the globe on the other is that the epithelium covering the former is thin and cylindrical, while that of the latter is thicker and flat.

In what way do these two morphological differences, the varying number of cells in the subepithelial tissue and the different nature of the covering epithelium, establish a predisposition to the development of follicles? This is a very difficult question to answer. Yet it is probable that these conditions, though not alone, form the anatomical substratum of the local predisposition of the tissue. The question concerning the formation of follicles in the conjunctiva is still more complicated because this membrane is, as rightly claimed by H. Virchow, subject to great individual variations in its structure, a matter to which I shall return later.

To summarize briefly:—Three factors are necessary for the formation of follicles; external irritation varying in strength and duration, general bodily predisposition, and a local tissue predisposition.

5. THE CHANGES IN THE SUBEPITHELIAL CONNECTIVE TISSUE OF THE CONJUNCTIVA IN TRACHOMA, ASIDE FROM THE GRANULES.

I have said already that the subepithelial tissue of the conjunctiva should not be called adenoid. Here we find the histiocytes of Kiyono in the greatest abundance, with less numerous plasma cells of Marschalko and lymphocytes. The number of fibroblasts also is increased.

The fact that in trachoma the fibroblasts are the earliest to proliferate can be demonstrated best in the region of the plateaus and grooves. This region, as indicated by its name, is characterized by numerous grooves with flat elevations between them (plateaus of H. Virchow). It not infrequently happens that one may find a plateau with a little follicle and another immediately adjacent with no follicle, both provided with many newly formed young fibroblasts (Fig. 4), together with the other kinds of cells mentioned above. This seems to me to show most clearly that the proliferation of fibroblasts in trachoma is not an accompanying symptom, but a sort of reaction of the tissue itself to the trachoma virus. Consequently I cannot concur in the idea that has been frequently advanced (*e. g.*, by Goldzieher) that cicatrization begins exclusively in the neighborhood of broken-down granules. It cannot be denied that after their contents have become softened by young connective tissue cells the granules are replaced and finally become cicatricial, but this mode of cicatrization cannot be regarded as an essential feature of trachoma. My idea is that the softening of the contents of the granule is rather a consequence of a cicatrization which develops gradually in the course of time in the tissue about the granules. A granule is composed of cellular tissue with a faulty vascular supply; impaired nutrition due to cicatrization in the surrounding tissue finally induces a retrogressive metamorphosis of its constituents. Cicatrization may therefore take place quite independently of the granules wherever trachomatous infiltration is present, whether in the conjunctiva of the tarsus, fornix, or globe, or in the cornea. Ichikawa (44) has demonstrated that a trachomatous granular proliferation with consecutive cicatrization occurs in the bulbar conjunctiva.

In short, the changes in the subepithelial tissue in trachoma, aside from the formation of follicles, consist of a chronic, granulating inflammation with an increase of lymphocytes, plasma cells, and histiocytes, and accompanied by young connective tissue cells which finally lead to cicatrization.

6. WHAT IS THE NATURE OF THE TRACHOMATOUS CHANGE?

The lack of agreement in the answer to this question has already been indicated. Some authors, who consider the formation of granules to be the characteristic of the trachomatous change, believe the granule able to excite trachoma in a manner analogous to that in which the tubercle produces tuberculosis (Goldzieher, *l. c.*). Saemisch (*l. c.*), Ichikawa (*l. c.*), and others consider the change in the subepithelial layer to be of chief importance, Saemisch taking the granules to be simply an accompanying symptom, Ichikawa thinking them an anatomical impurity.

My own opinion is that both changes, the granules and the granulating inflammation in the subepithelial layer, are intimately associated with trachoma, because both originate as the result of the reaction of the tissue to the trachoma virus, and that it is improper to consider either as the one characteristic of trachoma, as has been done so frequently. So long as the granule is the result of a reaction of the tissue to external injurious influence it is wrong to exclude it from the list of trachomatous changes, and the same is true of the subepithelial proliferation. But in my opinion the latter far exceeds the former in gravity, for the proliferation of granulations in the subepithelial layer occurs only in trachoma, tuberculosis and syphilis being excluded, while the formation of follicles is met with very often in other forms of conjunctivitis. Ichikawa (*l. c.*) formerly denied that follicles could occur in pannus and in the bulbar conjunctiva on the ground that the subepithelial tissue at the limbus lacks the adenoid nature which he thought was an indispensable precondition to their formation. This position is not tenable because it has been positively ascertained that occasionally, though rarely, follicles do occur in pannus. Yet the conclusion that the process of trachoma is always able to produce follicles, even in places where the so-called adenoid layer is normally absent (Axenfeld, *l. c.*, Komoto, 45, Meyerhof, 46), is in my opinion premature. For example Axenfeld (*l. c.*) says: "For the conjunctiva, in which the anatomical previsions are present, the follicle formation is characteristic of the trachoma virus. In the cornea they can never develop typically on account of the different anatomical conditions; it is only when a corresponding degree of loosening and a mighty layer of trachomatous infiltration has developed that follicles can appear here." If this view is correct it is essential that the pannus must be thick for the follicles to appear, but this is by no means the case. I can affirm from many years of experience with abundance of material that when follicles do occur they may be found in thin, quite small pannus. Many of Pascheff's (*l. c.*) illustrations indicate the same. Axenfeld's theory is therefore a mere surmise.

The formation of follicles in pannus and in the conjunctiva bulbi can be explained, just as in the fornix, by an exceptional special predisposition which favors the process there in certain cases, and we must not overlook the fact that the conjunctiva of the limbus and of the globe are particularly marked by variations in structure, as pointed out by H. Virchow (*l. c.*). In addition to many variations to be found here normally, affecting chiefly the number and strength of the papillæ, the thickness of the epithelial layer, and the number of beaker cells, I have found one which has never before been described—the occurrence of cylindrical cells in the epithelial layer. The bulbar conjunctiva is covered, as a rule, by laminated epithelium, and I was considerably surprised while examining histologically a normal conjunctiva at the limbus to find all the neighboring conjunctiva covered with cylindrical epithelium (Fig. 5). Unfortunately the sections were not arranged in series, so

I could not determine the extent of the area thus covered. This finding shows at least the possibility that occasionally an island of conjunctiva may occur at the limbus which is constructed morphologically like that of the fornix, a matter that must be of importance to the pathology of the conjunctiva. When trachoma invades such a conjunctiva follicles must surely form in the pannus without any such loosening as Axenfeld (*l. c.*) supposes.

Aokage (47) reported another condition which he interpreted similarly. In a boy sixteen years old he found close to the upper outer limbus a pale yellow, subconjunctival, movable tumor, half as large as a grain of rice, which was said to have been present since childhood, and to have increased in size rather rapidly recently, after the patient had had an acute catarrhal conjunctivitis. The histological examination of the extirpated tumor showed it to be composed of glandular lobules exactly similar in structure to Krause's glands. This proves that the subepithelial tissue at the limbus can have at times a structure morphologically similar to that of conjunctiva fornicis.

The formation of follicle at the limbus is therefore not to be interpreted in the way it has been by Axenfeld (*l. c.*) and Komoto (*l. c.*), but rather as the consequence of an occasional occurrence of trachoma in a limbus predisposed to such a formation by a variation in its structure. Without this inherent predisposition in the tissue trachoma can, of itself, produce no follicles in the limbus. The rare occurrence of follicles in pannus is to be ascribed to the lack of predisposition at the limbus, and this lack is explained by the rarity of the above-mentioned variations.

It is therefore incorrect to argue that the formation of follicles in pannus is a proof that trachoma is always able to produce follicles in the way that tubercles excite tuberculosis.

Although the follicles is a reaction product of the tissue to the trachoma virus and consequently is one of the trachomatous tissue changes, it is of much less consequence and importance than the proliferation of granulations in the subepithelial layer.

I cannot concur in the theory that lymph nodules occur also in the tarsus, as I have never found them there. The formation of lymph nodules in the lacrimal gland described by Matsuoka (48) may find its explanation in the presence of collections of lymph cysts, which are present normally in this organ, as Axenfeld (49) has long since shown.

7. CONCLUSIONS.

1. The substantia propria of the conjunctiva consists of a connective tissue layer permeated more or less richly with histiocytes of Kiyono, plasma cells of Marschalko, and lymphocytes, but with the last two in much smaller numbers. Contrary to the widely accepted theory the substantia propria has no adenoid nature, as H. Virchow rightly insisted.
2. Lymph nodules do not exist in the normal conjunctiva; they are always a reaction product of the tissue to some external irritation which may vary in duration and strength.
3. Two other factors take part in the formation of follicles in the conjunctiva, the general bodily constitution and a local predisposition.
4. These two factors are connected with the age of the person and with the anatomical structure of different parts of the conjunctiva. Sometimes the varying richness of cells in the subepithelial layer and the form of the epithelium, whether cylindrical or flat, are of special importance.
5. In addition to the formation of lymph nodules and the increase of histiocytes, lymphocytes, and plasma cells, a proliferation of fibroblasts takes place early in trachoma, so that a peculiar granulation tissue is formed in the subepithelial layer. Trachoma is, therefore, a sort of chronic granulating inflammation.
6. The proliferation of granulations and the formation of lymph nodules are both important in the pathology of trachoma, as both are reaction products of the tissue to the trachoma virus.
7. But the latter is less important than the former; for wherever trachoma breeds harm the proliferation of granulations occurs with consecutive cicatrization, while follicles are absent where the local predisposition is lacking, as in the bulbar conjunctiva and pannus.
8. Follicles do occur in pannus, but this does not mean

that trachoma as such and by itself is able to produce follicles as claimed by Axenfeld and Komoto. The rarity of such an occurrence contraindicates this. It is only occasionally, when an anatomical variation at the limbus gives a favorable condition, that follicles are formed.

9. Such a variation may sometimes be due to the presence of cylindrical epithelium in the epithelial layer, as I have shown. Aokage's finding was also a sort of variation in the subepithelial layer.

LITERATURE.

1. LINDNER. "Zur Biologie des Einschlussblennorrhoe- (Trachom-) virus." v. Graefe's *Arch. f. Ophth.*, lxxxiv., 1913.
2. LOEHLEIN. "Epitheleinschluesse und Trachom." v. Graefe's *Arch. f. Ophth.*, lxxxiv., 1913.
3. JUNIUS. "Die Pathologische Anatomie der Conjunctivitis granulosa." *Zeitschrift f. Augenheilkunde*, vii., Ergaenzungscheft, 1902.
4. SAEMISCH. "Conjunctivitis granulosa." *Handb. d. Augenheilk.*, Bd. v., 1 Abt., 2 Aufl., 1904.
5. GOLDZIEHER, W. u. M. "Beitrag zur pathologischen Anatomie des Trachoms." v. Graefe's *Arch. f. Ophth.*, lxiii., 1906.
6. ICHIKAWA. "Beitrag zur Trachomfrage." v. Graefe's *Arch. f. Ophth.*, lxxiii., 1913.
7. MUTERMILCH. "Aetiologie und Wesen des Trachoms." v. Graefe's *Arch. f. Ophth.*, lxxiii., 1913.
8. PASCHEFF. "Recherches sur la natur et l'étiologie du trachoma vérum." *Arch. d'Ophtalm.*, xxxi., Janvier, 1910.
9. PASCHEFF. "Trachoma verum corneae." v. Graefe's *Arch. f. Ophth.*, lxxxvii., 1914.
10. AXENFELD. *Die Aetiologie des Trachoms.* Jena, 1914.
11. BENDZ. "Compte rendu du congrès d'ophtalm." Paris, 1858. (Cited by Junius.)
12. RAEHLMANN. "Pathologisch-anatomische Untersuchungen ueber die follikulaere Entzuendung der Bindehaut des Auges oder Trachom." v. Graefe's *Arch. f. Ophth.*, xxix., 1883.
13. VILLARD. "Re. sur l'anatomie pathol. de la conjonctivite granuleuse." *Arch. d'ophtalm.*, xvi., 1896.
14. PICK. "Zur Histologie des Trachoms." *Arch. f. Ophth.*, xliv., 1897.
15. ADDARIO. "Anatomische und bacteriologische Untersuchungen ueber das Trachom." *Arch. f. Augenheilk.*, xli., 1900.
16. GREEF. "Conjunctivitis granulosa." Orth's *Lehrbuch d. spez. patholog. Anat.*, 1902.
17. JACOBSON. "Ueber Epithelwucherung und Follikebildung in der Conjunctiva mit besonderer Beruecksichtigung der Conjunctivitis granulosa." *Arch. f. Ophth.*, xxv., 1879.
18. AXENFELD. *Lehrbuch der Augenheilkunde.* Jena, 1915.

19. STOEHR. "Zur Physiologie der Tonsillen." *Biol. Centralbl.*, ii. (Cited by H. Virchow.)
20. STOEHR. *Lehrbuch der Histologie.* 15 Aufl., Jena, 1912.
21. KIYONO. *Die vitale Karminspeicherung.* Jena, 1914.
22. WEIDENREICH. "Zur Morphologie und morphologischen Stellung der granulierten Leukozyten-Lymphozyten des Blutes und der Lymphe." *Arch. f. mikr. Anat.*, Bd. 73, 1909.
23. KRAUSE. "Ueber die Druesen der Conjunctiva" in der *Zeitschr. f. rationelle Medecin*, iv., 1854. (Cited by Kleinschmidt.)
24. HENLE. "Zur Anatomie der geschlossenen (lenticularen) Druesen der Follikel und der Lymphdruesen" in der *Zeitschr. f. rationelle Medecin*, xxx., Bd. viii., 1860. (Cited by Kleinschmidt.)
25. SCHMIDT. *Lymphfollikel der Bindehaut des Auges.* Wien, 1871. (Cited by H. Virchow.)
26. KLEINSCHMIDT. "Ueber die Druesen der Conjunctiva." *Arch. f. Ophth.*, ix., 1863.
27. BAUMGARTEN. "Ueber die tubuloesen Druesen und die Lymphfollikel in der Lidconjunctiva des Menschen." *Arch. f. Ophth.*, xxvi., 1880.
28. SCHWALBE. *Lehrbuch der Anatomie des Auges.* Erlangen, 1887.
29. STOEHR. "Ueber den Bau der Conjunctiva palpebrarum." *Sitzungsb. die physik.-med. Ges. in Wuerzburg*, 1885. (Cited by H. Virchow.)
30. VIRCHOW, H. *Graefe-Saemisch Handb. d. Augenheilk.*, 2 Aufl., 1 Bd., 2 Kap.
31. WALDEYRER. *Ibid.*, 1 Aufl., 1 Bd., 1 Teil, 1874.
32. STROMEYER. "Beitraege zur Lehre von der granuloesen Augenkrankh." *Deutsche Klinik*, No. 25, 1859. (Cited by Saemisch.)
33. BLUMBERG. "Ueber das Trachom vom cellularpathologischen Standpunkte." *Arch. f. Ophth.*, xv., 1869.
34. WOLFRING. "Ein Beitrag zur Histologie des Trachoms." *Ibid.*, xiv., 1869.
35. SATTLER. "Beitrag zur Kenntniss der normalen Bindehaut des Menschen." *Ibid.*, xxiii., 1877.
36. REICH. "Zur Histologie der Conjunctiva des Menschen." *Ibid.*, xxi., 1878.
37. HIWATARI. "The Pathological Anatomy of Trachoma." *Nippon-Ganka-Gakkwai-Zasshi*, xxi., 1917.
38. STOERK. "Zur Pathologie der Schleimhaut der harnleitenden Wege." Ziegler's *Beitraege zur pathologischen Anatomie und allgemeinen Pathologie*, xxvi.
39. AXENFELD. "Erkrankungen der Conjunctiva." *Lehrb. d. Augenheilkunde*, 4 Aufl., Jena, 1915.
40. SAEMISCH. "Conjunctivitis follicularis." *Graefe-Saemisch's Handbuch d. Augenheilk.*, 2 Aufl., v. Bd., 1 Abt., iv. Kap.
41. ZEHENDER. *Handb. d. ges. Augenheilk.*, 3 Aufl., i. Bd., 13, 1874.
42. RADOS. "Die Ausscheidung von intravenoes injiziertem Karmin und Trypanblau im Auge." *Arch. f. Ophth.*, lxxxv., 1913.

43. Schnaudiegel. "Die vital Faerbung mit Trypanblau am Auge." *Ibid.*, lxxxvi., 1913.
44. Ichikawa. "Ueber die trachomatoese Veraenderung der Skleralbindehaut." *Ibid.*, lxxix, 1910.
45. Komoto. "Concerning the Presence of Typical Trachoma Follicles in Pannus and in the Conjunctiva Bulbi." *Nippon-Ganka-Gakkwai-Zasshi*, xvi., 1912.
46. Meyerhof. "Ueber Follikebildung im Hornhaupannus bei Trachom." *Klin. Monatsbl. f. Augenheilk.*, Bd. 46, 1908.
47. Aokage. "Concerning the Occurrence of Accessory Lacrimal Glands at the Limbus." *Nippon -Ganka-Gakkwai-Zasshi*, xxii., 1918.
48. Matsuoka. "Trachomatous Change of the Lacrimal Gland." *Ibid.*, xx., 1916.
49. Axenfeld. "Bemerkungen zur Physiologie und Histologie der Traenendruese." *Bericht der ophthalm. Gesellschaft*, xxvii., Heidelberg, 1898.

ATYPICAL ALBUMINURIC RETINITIS.

By Dr. C. A. CLAPP, Baltimore, Md.

(*With two illustrations on Text-Plate IX.*)

ONE becomes so accustomed to think of albuminuric retinitis in the form of star-shaped exudates, and especially is this so of internists who are using the ophthalmoscope upon their nephritic cases, that I believe it wise to briefly record the history of the following case with drawings of the fundi.

A. M. (Male.) Age 18. Was first seen September 28, 1912, complaining of headaches. Patient had tonsils cut and adenoids removed several years previously. Examination showed stumps of tonsils which were fairly healthy with large mass of adenoids. The adenoids were ordered to be removed and small error of refraction corrected. Fundi normal; headaches relieved. In April, 1914, there was a slight change in refractive error under atropin but fundi were normal.

Patient entered Johns Hopkins Hospital in June, 1918, at which time a diagnosis of acute nephritis was made and stumps of tonsils removed.

Consulted us again on January 28, 1919, stating that vision had been defective since his illness in June, 1918, but that he seemed to be seeing a little better than at that time.

Examination showed slightly dilated pupils, but both reacting to light with a vision of $\frac{20}{200}$ in each eye, not improved by lenses.

The right fundus showed (see Fig. 1) slight fullness of nerve with beginning pallor, vessels full and tortuous. In macular area there was a small round circumscribed area of a pearly white appearance, near the circumference of this area was a small amount of pigment; surrounding this small circumscribed area which seemed to be slightly depressed

ILLUSTRATING DR. CLAPP'S ARTICLE ON "A TYPICAL ALBUMINURIC RETINITIS."

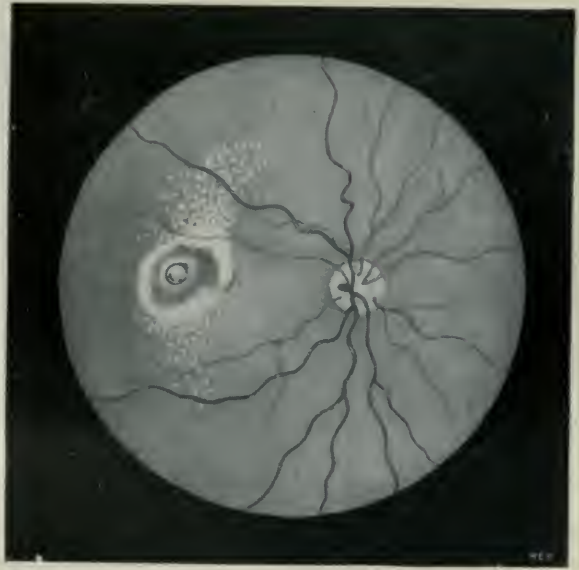


FIG. 1.
Right Eye.

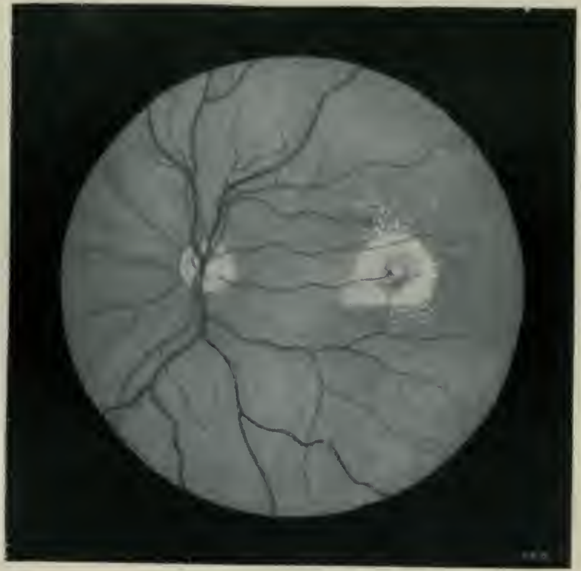


FIG. 2.
Left Eye.

was a large yellowish white area several times larger than the nerve head with an irregular area of pigment collected between the center and its circumference extending from the small central area over the larger yellowish white area were very fine white lines, probably connective tissue trabeculæ; superimposed over the pearl white center were some very fine droplets suggestive of fat drops. These were focused 0.5 D. in front of circumscribed round area: above and below the large yellow area were the ordinary fine yellowish exudates.

The left eye showed (see Fig. 2) a very similar change except that the condition seemed more recent, in that the outlines of nerve were more blurred, probably slightly more retinal œdema, and the central pearly white area was not so circumscribed and the collection of pigment in this area and in the surrounding yellowish white portion was less pronounced than in the right eye, the fatlike droplets over central area were larger and more numerous with practically no radiating connective tissue strands from macula; the small exudates above and below the central mass were also fewer in number.

From the scientific standpoint we regret that we cannot complete the study by a microscopical examination and one is almost tempted to think that this is not a case of albuminuric retinitis, but the diagnosis of the internist after a very thorough survey and with a negative Wassermann was acute parenchymatous nephritis so our only alternative as we see it is to record it as "Atypical Albuminuric Retinitis."

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

An ordinary meeting of the Section was held on Wednesday, June 4th, under the presidency of Mr. W. T. **Holmes Spicer**.

Mr. J. **Herbert Fisher** exhibited, by means of the epidiascope, a life-size drawing through the center of the optic chiasma, to show the pedicle of the pituitary body and the intimate relationship between the lateral boundary of the pituitary body and the inner wall and internal carotid artery. This artery, having come forward in the floor of the cavernous sinus, made a bend with its convexity forwards as it ascended to pass on the mesial aspect of the clinoid process on its anterior aspect. It also showed the ophthalmic artery coming off. Mr. Fisher considered that if there were a swelling of the pituitary body, of either a transient or permanent nature, it was very likely to cause an immediate effect on the carotid artery in the way of indenting its inner wall and so interfering with the blood flow, and producing thereby an effect on the cerebral, and possibly also the retinal, circulation. This section seemed to support the view he recently brought before the members, that possibly an abnormal state of the pituitary body might be responsible for some varieties of migraine, and explain such attendant symptoms as aphasia. Some further support was derived from the fact that during an attack of migraine it was common for the superficial temporal artery to be tense and cordlike. If the enlarged pituitary caused compression as he suggested, then more of the blood brought up the neck by the common carotid must be diverted and fill up the branches of the external carotid, of which the temporal artery is the most easily investigable.

Mr. L. V. CARGILL showed a case of **pigmented connective tissue** in front of the optic disk of the left eye. When this soldier was in France, he was struck in the face by shrapnel in 1918. As the man was complaining of blindness, his condition was described there as evulsion of the optic nerve. It did not have that appearance, however. The history showed that the man had had no vision in that eye before he was recruited. The disk of the left eye was practically hidden by this mass, which projected beyond the level of the fundus some 3 to 5 diopters. From some of the radiating white streaks, blood vessels could be seen to emerge. He thought it must be due either to some defect of a congenital nature, to trauma, or to inflammatory change. His view was that it was due to a hemorrhage, which might have occurred at birth. Obviously it had no relationship to the facial injury by shrapnel.

Mr. F. A. JULER showed a patient with **obstruction of retinal vessels, with patent vessels,** following an electric flash. This case of embolism of the central artery of the retina showed some unusual features. The part of the retina on the outer side of the disk looked healthy and was not opaque, and there was a small cilio-retinal vessel supplying this part of the retina. With regard to the nature of the obstruction, the man had an extensive heart lesion, which Dr. Langmead regarded as probably congenital. At this date, a fortnight after the onset, the retinal arteries of this eye had as large a caliber as that of the other eye vessels. The existence of the heart lesion made it difficult to escape the view that the obstruction was due to embolus in the central artery of the retina. The man was engaged in his electrical work, when a flash took place about six feet from him, and two hours later the eye was gradually becoming blind. An hour later the sight came back almost completely. When, however, he went to sleep shortly afterwards he awoke with the eye again blind. The diminished force of the heart's action during sleep probably enabled the blockage of the artery to again become complete. The question of compensation having arisen, he gave the view that there was a causal connection between the flash and the blindness.

Mr. Foster Moore exhibited a case of **melanoma of the choroid,** which had remained stationary for five and a half years. It showed the characteristic "blue ointment" color, which was uniformly distributed over the growth. It was only discovered on routine ocular examination. The pigment appeared to be intracellular.

Mr. E. M. Eaton contributed an exhaustive paper, illustrated by many slides, on **visual perception of solid forms.** He showed that the binocular element was the essential factor in stereoscopic vision. The stereoscopic quality was not an exclusive attribute of binocular vision. It must be recognized that as experience was added, sensation came more and more to assume an objective character, and ultimately it became undifferentiable from perception. This was not equally true of any other sense, if indeed it were so at all. In the ordinary view of objects there was no conscious relic of the abstract sense of light: there was merely an impression of the perception of the object seen. It was possible to so suppress the image of each retina that each perception was a composite view made up of part of the image of one eye, and part of that of the other. If two retinal images did not fit each other satisfactorily, it was possible to automatically cut off the projecting portions. In fact, in only a few circumstances did one utilize the whole of both retinal images. When it was said that by means of binocular vision a view could be obtained around objects, it really meant that spaces behind them could be appreciated, as in looking across a sandy desert in sunshine and perceiving the air agitation due to altering states of atmospheric density and therefore refracting power.

Colonel J. H. Parsons spoke of the great value of the paper, especially in connection with the visual problems of aviation. He said the contribution invited very careful study.

The Section held its first meeting of the season on Wednesday, November 5th, under the presidency of Mr. W. T. Holmes Spicer.

Dr. Rayner D. Batten showed a case of **acute disseminated choroidoretinitis,** of doubtful origin. The changes all took place practically while the patient was under observation. He was first seen by the exhibitor at the end of March last. Three weeks previously to returning home demobilized, he had lost central vision in the right eye. A nearly flat subretinal patch was found to the temporal side of the optic disk, below the superior branch of the retinal vessel. It was about one third the size of the disk, and was triangular in shape. A small retinal vessel passed over it, and it was surrounded by an area of œdema. The remainder of the right fundus and the whole of the left fundus were normal. The eye was examined about once a week. Towards the end of May, the whole of the right fundus was thickly strewn with patches of choroiditis, and these could still be seen in much the same condition. The central patch had now subsided, and the vision had improved. As the appearance was strongly suggestive of syphilitic choroiditis, a Wassermann test was twice done, but was negative: there was no other evidence of that disease about the man, and he strongly denied the possibility of such infection. In December, 1916, when on military service, he had a wound on the foot, which was very tardy in healing. The area of the wound was still tender to pressure. A surgeon had declined to open up the foot again, on account of the stubborn healing on the former occasion. In August last the vision was: right $\frac{6}{18}$, left $\frac{6}{6}$. When seen on October 2d, there was a history of sudden failure of vision in the left eye three weeks previously, with a central black spot. Later, a similar condition was found in the right eye, the vision in that eye being $\frac{6}{9}$, the vision in the left having been reduced to $\frac{6}{36}$. He asked opinions as to the likelihood of further attacks, and as to the probable causal agent.

The PRESIDENT thought the involved area was raised above the general level of the fundus, and his view was that the cause was sepsis, from the original focus in the foot.

MAJOR J. F. CARRUTHERS, R. A. M. C., showed an unusual case of **optic nerve tumor.** The patient, 21 years of age, was not aware of anything wrong with his vision until he was 14. His attention was drawn to his eyes, however, by increasing dimness of sight of one. As his other eye was good, however—it was still $\frac{6}{6}$— he paid no attention to it. He later had dragging pain at the back of the eye, and last June he attended the Herbert Hospital for treatment. A consultation was held, and operative measures were discouraged. The man returned to work, but came again in July, and then the eye was found to be quite blind, and the pupil did not react to either light or accommodation, only consensually with the other. The pain he, the speaker, did not attach much importance to, as it did not seem to deter from sleep or enjoyment. There had been no injection of the conjunctiva, and the media were clear. In July, there was a pearly-white organized mass covering the whole anterior surface of the optic nerve: no hemorrhages nor even vessels were apparent in or on it. There appeared to be a retino-choroidal rupture, and the structures inside a pigmented ring were evidently being drawn towards the under surface of the tumor. There was very little sign of progress since July.

Mr. HUGH THOMPSON, who saw the case in June, thought it was probably a birth injury to the nerve, a view in which several colleagues agreed. With the exception of a little more pigmentary disturbance, he saw no evidence of advance.

Mr. M. S. MAYOU suggested the possibility of the tumor being tuberculous, and asked whether the man had been investigated from that point of view.

Mr. LESLIE PATON referred to a similar case, though of less degree, which he showed before the Ophthalmological Society ten years ago. In that case there was no sign of rupture of the choroid. The discussion on it showed that most members considered it a congenital malformation in the connective tissue of the disk. The question whether or not this growth was progressing was an important one in considering whether the eye should be removed.

COLONEL PARSONS said Mr. Paton's case was one in which there was a little mass at the edge of the disk. There was no absolute proof that the lesion was a growth. The eye was excised. The section gave an appearance exactly similar to Coats's disease, exudative retinitis; it was in a very early stage. He thought it very likely that the present case was one of birth injury at the head of the nerve, with subsequent cicatrization.

MR. TREACHER COLLINS suggested that there had been some hemorrhage into the vitreous, and that the white mass in front of the vitreous was organized fibrous tissue.

MAJOR CARRUTHERS replied that no tuberculous or other disease was found at the medical examination, and the urine was normal.

Mr. H. R. JEREMY and Mr. MCMULLEN showed cases of **supposed avulsion of the optic nerve head.** Mr. MALCOLM HEPBURN did not agree with the description.

COLONEL PARSONS exhibited a case showing **bilateral changes in the macula.** When the young man's mixed astigmatism was corrected, his vision was practically normal. He entered the army unaware of any optical defect, and remained three years, until he was examined again before leaving for Egypt with a draft. Then Mr. Secker Walker, of Leeds, finding the macular changes, quite rightly secured his release. The changes were of long standing, and he thought it likely they were caused by colloid bodies in the choroid. These bodies were usually found in elderly people, but they were found in young subjects of retinitis pigmentosa.

Mr. TREACHER COLLINS thought the condition was probably retinitis circinata, *i. e.*, *hemorrhages into the retina itself*, organizing into white masses. The white patches round the disk seemed to be too extensive for ordinary colloid degeneration.

The PRESIDENT took the same view of the case as that expressed by Colonel Parsons. In retinitis circinata there was, he believed, always some loss of vision, and generally the macula was very gray in appearance, what had been well described as a "Passover bread appearance"—white masses with black holes in them.

Mr. R. R. CRUISE showed a patient six months after a **plastic and grafting operation on a damaged socket** for the purpose of wearing an artificial eye. It showed either that the conjunctiva had encroached at the expense of the skin, or the graft itself had been so altered by the constant orbital moisture as to approximate to conjunctiva. He reëmphasized the points he made when showing the case before the Ophthalmological Society six months ago.

The PRESIDENT expressed the congratulations of the Section to Mr. Cruise for his skill.

Mr. SIMPSON showed a case of **probable partial avulsion of the optic nerve.**

Dr. RAYNER D. BATTEN then read a paper on

The Need of Ophthalmic Physicians for the Advancement of Ophthalmology.

Dr. Batten said the question discussed in his paper arose when a vacancy occurred on the staff of the hospital to which he is attached and he urged that an ophthalmic physician rather than a surgeon was required. His arguments in favor of such an appointment were met by the reply that it was "not done" at other hospitals, and that, moreover, no men were available who had been educated for such a post. He was invited to bring forward the matter at the Royal Society of Medicine, and he now asked for an expression of opinion from members of the Section, not only as to the appointment of ophthalmic physicians for ophthalmic hospitals, but on the whole question of the education of ophthalmic men.

Cases requiring direct surgical treatment formed such a small part of the ophthalmologist's work, that he had to be responsible for a far larger clinic than he could personally attend to if it was to yield sufficient operative material for the study and advance of the specialty. Hence large numbers of men were educated and given posts as clinical assistants and given much responsibility: they became able ophthalmic observers, but were given no training in ophthalmic surgery, while their knowledge of medicine was insufficient to make them ophthalmic physicians. The further advances in ophthalmology promised to be mainly on medical lines, therefore men with a physician's training and experience would be needed. New operations might continue to be evolved for glaucoma, the best form of cataract extraction could still be discussed, and some day there might be a successful operation for detachment of the retina or for conical cornea, though he doubted whether success in these conditions was likely to come from the surgical side. On the medical side, however, there were endless possibilities, which the ophthalmologist tried to tackle with his detached scraps of medical knowledge. The position of physicians attached to ophthalmic hospitals was that of consulting referees: they did not have patients of their own, for which they were answerable. Even in well-marked medical cases, the responsibility rested with the surgeon. In private practice, the responsibility was, more often, shared: and here, even if a case was referred to a physician, he was seldom in a position to study it from the ophthalmic point of view. At present the consulting physicians were not appointed for their knowledge of ophthalmology, but for their acquaintance with some branch of medicine, often the neurological. The need was for ophthalmic physicians who would do their own work, who would have to live, so to speak, with their ophthalmic failures.

Among the instances in which the medical study would be valuable that he gave were: 1. Various vascular conditions associated with changing blood pressure, arteriorsclerosis, vascular degeneration, thrombosis, and conditions associated with renal, hepatic, and cardiac diseases. 2. Diseases of the central nervous system, not only the gross and obvious ones, but such obscure ones as unexplained optic atrophies, headaches of, apparently, visual origin but without ocular defects. 3. The toxic and septic conditions causing ocular diseases, such as iridocyclitis, concerning which knowledge was in an unsatisfactory state. Such cases were at present referred to the consulting physician, dentist, pathologist, etc., and after a negative report had been received from them all, the case returned for empirical treatment, whereas it ought to come back to the physician, who should "live with" it until he had found a cause. There was great need for improved training in research from the medical side. Lastly, he mentioned various nutritional diseases, giving rise to corneal ulcers. Education as surgeons seemed to dull keenness and the power of investigating primary causes of certain ophthalmic problems: there was a hesitancy to stray beyond the orbit. In the case of cataract, in the ultimate issue operation could be done to relieve the worst of the symptoms: most of the systems of treatment depended on some local application to the eye, and were not based on investigation as to the cause. The fact that some cataracts would start rapidly and, after reaching a certain stage, become quiescent, pointed to some constitutional cause, one beyond the present power of recognition by surgeons. And he did not see how any thoughtful man could be satisfied with either the surgical diagnosis or treatment of many cases of glaucoma. There were a number which defied surgical treatment, and did not exhibit any of the anatomical causes, yet they progressed. Moreover some of the acute cases showed a virulence for which no anatomical explanation sufficed. He did not consider it was creditable to the ophthalmologist that, glaucoma having occurred in one eye, he was unable to prevent its onset in the other, except by operation. The attitude of the specialty towards detachment of the retina was even more hopeless.

The prime fault in this matter lay in the present system of educating the ophthalmologist, who was required to pass the highest examination in general surgery, a large part of which had no bearing on eyes: his time would be better spent in acquiring some knowledge of medicine and of his own specialty. At present, a man might work ten or fifteen years at a leading ophthalmic hospital without doing a major ophthalmic operation. His skill in this must be gained in the school of experience, which was expensive alike to surgeon and patient.

It was undesirable to attempt to teach operative work to all the young men passing through the hospitals seeking ophthalmic training: it would be unjust to both patients and the hospital to attempt to do so. Ophthalmic surgery differed from all other surgery in that there was, in it, no gradual road to competence: one could not allow a man to *begin* an operation, such as that for cataract, and, if he got into difficulties, step in and set things right. The mischief was already done—and men had only two eyes. The present position, he declared, was not fair to the public, nor to the honor of ophthalmic surgery: he would have ophthalmic operations in fewer hands than at present. This would mean not only a higher standard by operative skill, but enterprise and progress in surgical treatment. It would then be possible to have private ophthalmic hospitals, equipped for these special operations: this would be much preferable to having to depend on nursing homes, where eye operations were infrequent, and the nursing means not satisfactory.

In place of the Fellowship he would have an ophthalmic qualification, and it should be possible to qualify either medically *or* surgically, for the latter there must be evidence of operative skill. For the ordinary medical qualification, men were required to have attended 20 or 30 cases of midwifery: was it too much to ask that before a man was admitted as an ophthalmic surgeon he should show some operative skill in this department?

Physicians could be appointed to ophthalmic hospitals at once: they should attend out-patients, and have beds at their disposal. They should see all classes of cases, but should be relieved of all operative work. Both physicians and surgeons would benefit greatly by constant close association, and the system he advocated would redound to the credit and advancement of ophthalmology.

The paper will be debated at the next meeting of the Section.

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. ELLICE M. ALGER, Secretary.

MONDAY EVENING, OCTOBER 20, 1919. DR. ARNOLD KNAPP, CHAIRMAN.

After the reading of the minutes of the last meeting, Dr. Carl Koller presented a patient with **megalo-cornea,** on whom he had successfully performed a **cataract extraction.**

Dr. M. J. Leavitt showed a patient (previously shown) with **recurrent paralysis** of the **right external rectus,** there having been thirty attacks within the last twenty years.

Dr. Martin Cohen presented a patient with a large **implantation cyst of the iris.**

Male 32 years old. Received injury to the right eye by being struck with a chip of steel from a tool three years ago. He was at once taken to the Binghamton Hospital for X-ray examination to localize the foreign body. This examination was negative. The patient complained of pain and returned to his physician after four weeks when a piece of steel of hair-like caliber a ¼ of an inch long was removed from the nasal side of the corneoscleral margin with forceps. The aqueous at once exuded from the wound when the foreign body was removed. Slight pain recurred now and then after its removal.

The patient first presented himself at the Manhattan Eye and Ear Hospital on the service of Dr. David Webster about a week ago, who made a diagnosis of implantation cyst of the iris of traumatic origin. The patient complains of intermittent pains in the eyeball and deterioration of vision. Examination of the right eye revealed the following: moderate external deviation of the eyeball. No evidence of any extraocular inflammation or tenderness of the eyeball on palpitation was present. Vision equaled motion of the fingers at two feet; light projection was normal and prompt in either direction, intraocular tension was eighteen with the Schiotz tonometer. At the nasal side of the sclerocorneal margin, there is seen a dense scar. The anterior chamber is of normal depth on the temporal side, but on the nasal side it is occupied by a large cystic tumor of mother of pearl appearance and translucent, probably due to a down growth of corneal epithelium which is implanted on the iris, and there goes on to proliferation and then degeneration. The anterior wall of the mass comes apparently close to the posterior wall of the cornea. On the inner wall of the mass one sees four sacculated indentations. The beginnings of these sacculations are bordered with retinal pigment extending slightly over the mass above and below. The posterior aspect of the mass is difficult to discern. The contents of the mass consist of granular detritus, fibrous elements, a few tinged with pigments, and fine strands of tissue extending from the sacculated indentations. Here and there is some pigmentary detritus. By transillumination one perceives a reddish reflex over the area of this mass, indicating that the pigment epithelial layer has become degenerated and absorbed and then replaced by the proliferated epithelium which lines the cyst wall. The pupil does not react either directly or indirectly. Its shape is slitlike and elliptical. The lens is cataractous and shrunken.

The question of operation or conservative treatment must be considered. Removal of the cystic mass by incision near the mass and then withdrawal of the cyst wall with forceps with excision might be considered, but owing to its large size it is questionable whether one or several operations would be practical. Eventually enucleation might be imperative.

DISCUSSION: Dr. JOHN E. WEEKS spoke of a somewhat similar case in which he had succeeded in removing the wall of the cyst with forceps and preserved the eyeball.

The subject of the evening, **Postgraduate Instruction in Ophthalmology,** was opened by Dr. MEYER WIENER of St. Louis with a paper on **experiences based on the recent military course in ophthalmology.** (Appears in this issue.) Dr. F. H. VERHOEFF of Boston, Mass., read the second paper on

some suggestions regarding the teaching of ophthalmology. (Appears in this issue.)

DISCUSSION.

Dr. EDWARD JACKSON of Denver. It is essential that the different subjects included in the graduate teaching of ophthalmology should be taken up in a certain logical order. We know that the undergraduate medical student is required to conform to a certain curriculum. He must study anatomy, physiology, pathology, and methods of diagnosis before he is allowed to follow clinical work. Only by such preparation for them can he profit to the fullest extent by the clinical opportunities that may be open to him. We should recognize that some such natural sequence of studies must be followed in preparation of the graduate for the practice of ophthalmology.

The undergraduate medical course does not give, and cannot give, the training in ocular anatomy, physiology, physiologic optics, ocular pathology, and methods of ocular examination, that are needed by one who undertakes special ophthalmic practice. But without them the time spent in following clinics cannot be used to the best advantage. These fundamental branches should precede the attendance on ophthalmic clinics.

With men well trained in the fundamental branches of general medicine and surgery, it is possible to give these fundamentals of ophthalmology in comparatively short courses of intensive training. But they should precede or come at the very beginning of clinical work if it is to be entirely helpful and satisfactory to the graduate student.

The need for this natural order in the graduate teaching of ophthalmology has been very imperfectly appreciated in the past. It would seem absurd to begin the general medical course with clinical study of any patient who happened to present himself, and to leave anatomy and pathology until later, or not require them at all. Yet something quite similar to this has been the common conception and practice in the graduate teaching of ophthalmology.

We should think this over carefully and then go out to do missionary work in the medical profession for this definite rational arrangement of a curriculum for the teaching of this special branch. When young men begin to realize that this is the only proper course of study to fit them for ophthalmic practice, there will arise an effective demand for the right kind of teaching—that which is systematic, complete, and given in the natural and proper order.

Dr. G. E. DE SCHWEINITZ of Philadelphia said he desired to speak not of the ideal course, but of the practical possibilities. The student material could be divided into three general groups: (1) a very small group of well qualified men who were specializing in ophthalmology, (2) a group of men fairly well qualified who were simply desirous of brushing up or learning special lines of work, and (3) the large group of no special training.

These groups ought not to be mixed up for instruction, but should be graded by examination, so far as they will stand for it. One of the great difficulties will be that of securing adequate instructors, and it would be necessary to utilize the undergraduate teachers so far as possible. He described the ophthalmological part of the new post-graduate scheme of the University of Pennsylvania which is to begin with a short session next year and be expanded into a two-year course as rapidly as practicable. Dr. de Schweinitz emphasized his points: that he was thinking of the practical and not the ideal; that the present preliminary instruction as given in the undergraduate schools was very inadequate and that the great question is that of handling the students that present themselves to-day. He did not see any way except by grading them. There would be in his opinion no reason why any one need go to Europe for instruction in ophthalmology.

Dr. W. H. WILDER, Chicago: This subject is one that looms large at the present time among the problems of modern medical education, and conditions arising because of the war bring it prominently before us.

The importance of it has been forced upon the attention of the American Board for Ophthalmic Examinations, one of whose functions you may remember is to propose standards of fitness for the practice of ophthalmology and to suggest courses of study and preparation to the person who desires to take its certificate.

After 1920, the Board will require that candidates for its certificate who have practiced ophthalmology less than five years must have a degree from a college that requires four years of medical study and a fifth year of clinical or laboratory work. In addition the candidate must give evidence of a year of special study of ophthalmology under competent instructors and another year of interneship in an eye hospital or in lieu of this an assistantship in an eye clinic or a private assistantship with a competent ophthalmologist.

At the present time the opportunities and facilities for this extra year of special study of the eye under competent instructors are very few. Indeed, there are few places in this country to which a man can go for systematic study and preparation that will fit him for any specialty in medicine unless he is fortunate enough to get the personal attention of a master in that subject who will direct him and give him the special opportunities.

If anything the situation is somewhat more favorable in this regard in ophthalmology than in neurology, dermatology, pediatrics, and other specialties, but we must all realize that in ophthalmology the facilities that can be offered in this country for the preparation of persons to meet the requirements of our Board, reasonable as they seem, are lamentably weak and few.

I cannot agree with one of the speakers who stated his opinion that an interneship in a general hospital or some time of general practice is not a valuable fundamental preparation for the study and practice of ophthalmology. If such an interneship was in a hospital where the person served all his time on some special branch other than the eye, it naturally would not be as valuable as one in which he had the opportunities of a rotating service, but even at that if the service included medicine or surgery, dermatology or neurology, it seems to me that it could not help being of advantage to him.

The training he would receive in such a course would probably give him a broader view of pathologic processes and there would be less danger from the narrowing influence that special practice is apt to exert upon any individual.

In our scheme of post-graduate instruction in ophthalmology it seems to me we must provide for three classes of individuals. FIRST—those who have time to take a prolonged course of two years or more in ophthalmology and its collateral subjects leading to some degree such as Ph.D. or S. M. Such courses might be provided for in the scientific schools and affiliated hospitals of the universities, which would naturally be the institutions to confer the degrees. But comparatively few would have the time or inclination to pursue such an extended course.

In the SECOND class will be those persons who desire to acquire a degree of proficiency and fitness that will make them safe practitioners of ophthalmology. On a good foundation they may build later skill and eminence.

The American Board for Ophthalmic Examinations thinks that this class should have a year of special study under competent instructors and a year of interneship in a special hospital or assistantship in a clinic or in private practice under a skilled ophthalmologist. Such a year's course should include fundamental branches such as anatomy, gross and microscopic of the eye and surrounding parts, embryology, pathology, bacteriology, physiology and physiologic optics, and these studies should be followed by the clinical subjects. Many persons may be unable to pursue such a course continuously for a year, and provision should be made so that certain subjects could be thoroughly covered in a given time. It would probably not be best to encourage courses of less than three months' duration.

Such instruction to be effective would have to be given to small classes or groups and this would necessarily require a large number of instructors. And right here will be encountered one of the great difficulties. How will the necessary number of men competent to give this instruction be obtained?

It will probably be some time before endowments will be forthcoming to support such technical instruction, and in the meantime the fees from students will have to furnish recompense for the instructors and meet other costs.

In the THIRD class for whom postgraduate instruction is required we find those persons who desire short courses of a few weeks at most, and who have no definite plans in their own minds of what they want, and have no time, ability, or inclination to follow any plan of intensive, sequential work that is offered them. Many of them are practitioners taking "brushing-up" courses, usually on the clinical side; many of them are men who have been failures in the practice of medicine and think that ophthalmology is easy and can be acquired in a three weeks' course. Such persons are usually satisfied at the cheapest postgraduate schools.

This class presents no interest to us in the consideration of this problem of graduate instruction, for those in it who are earnest and sincere would probably find their way with the SECOND class if facilities for proper instruction were offered.

There are comparatively few centers in this country where proper facilities exist for carrying on this important work. Even in those, it seems to me, it will be necessary to combine the resources of medical schools, special hospitals, and clinics to get the most effective and desirable results. And this means there will have to be a hearty unselfish coöperation on the part of those competent to carry on the work if we hope to solve the difficult problem.

Dr. WALTER R. PARKER, of Detroit. I speak with some reluctance on the subject of postgraduate teaching, as my senior class consists of but one man, who has already spent two years on the ophthalmological service. The ophthalmic department in the University of Michigan is so arranged that we have a three-year progressive service, one year as interne, one as assistant, and one as demonstrator. The whole staff assists in the demonstration work given the undergraduate students and, in addition, the third-year man conducts the quiz in junior ophthalmology, which covers instruction in embryology, physiology, and anatomy, also the use of instruments. The lectures to the juniors are given by the Assistant Professor in Ophthalmology, who is a member of the permanent staff.

The increased interest in the work incident to the teaching has been one of the outstanding features of the experiment, and the necessity of preparation has resulted in a better knowledge of the fundamental branches than might otherwise have been acquired.

To arrange a schedule of subjects to be taught is much easier than to provide the proper facilities for presenting the work required. Short courses given to students who are unequally qualified are most unsatisfactory, and it seems to me should be discouraged. When all that was asked of the student was to observe clinical work for a few months, it was a very different matter from requiring him to have a thorough knowledge of the fundamental branches of the subject as well as a clinical experience.

My experience as well as my observation leads to the conclusions that very little attention is paid to teaching the fundamentals to members of the resident staff. Much could be done by requiring each member to spend some time in the laboratories before being given clinical or ward work. A member of the staff or, after the plan is developed, the senior House Surgeon could give a systematic course in the fundamental branches of ophthalmology. Teaching institutions probably offer the best opportunity for giving the fundamental work leaving to the special hospitals the clinical teaching. It would seem in New York, a combination could be formed that would offer ideal opportunities for a complete course that would accommodate a large number of students.

The admirable plan as outlined by Dr. de Schweinitz to be developed at the University of Pennsylvania will offer a great opportunity for postgraduate work. I hope the courses will soon be extended to two years.

While the plan as developed at the University of Michigan during the past ten years is applicable to a very limited number, and may require many modifications, it is working out well however and may prove applicable to other teaching centers.

Dr. JOHN E. WEEKS laid stress on the desirability of a good knowledge of general medicine on which to build the superstructure of a specialty in medicine, and advocated a postgraduate interneship in some good general hospital or its equivalent. The postgraduate studies for the practice of ophthalmology should include embryology, special anatomy, normal and pathological histology of ocular tissues and physiological optics. The clinical training and the studies of refraction, ophthalmoscopy, surgical technique, etc., could then be added to the best possible advantage. The desired instruction in all its elementary phases can be best supplied by a large teaching body such as is found in our large universities, the various departments supplying the necessary instructors. Dr. DE SCHWEINITZ has outlined the ideal plan, and its development under his masterful direction will greatly aid those who aspire to acquire a sufficiently comprehensive knowledge of ophthalmology.

Dr. ALEXANDER DUANE emphasized the points made by some of the other speakers as to the value or the importance of various fundamental parts of ophthalmology which were more often taken for granted than taught and of the necessity of planning a course so that one detail led logically up to the next. After the fundamentals should come groups of symptoms and then the clinical work. The best teaching was that which was most individual and therefore the classes should be small and carefully graded as to ability while the teaching itself might well be a combination of lecture demonstration and quiz. He thought the making and study of case reports might be of great value.

Vol. XLIX. No. 2.

ARCHIVES OF OPHTHALMOLOGY.

OCULAR MANIFESTATIONS FOLLOWING EXPOSURE TO VARIOUS TYPES OF POISONOUS GASES.[1]

By GEORGE S. DERBY, M.D., Boston.

(*With four illustrations in color on Text-Plate X.*)

IN 1915, the Germans began to use gas for the purpose of disabling their opponents. This was first used in the form of drift or cloud gas. Among the varieties sent over was the so-called lacrimatory gas, which was used for the purpose of temporary disablement. Lacrimatory gas caused intense burning pain, profuse lacrimation, and injection of the conjunctiva. The men who had been gassed showed marked photophobia and watering, the palpebral borders were swollen and showed erythematous lesions, which followed rubbing with the hand and the handkerchief. There was marked conjunctival injection and occasional chemosis. According to Gremeaux (1), the cornea presented in its peripheral portion a fine exfoliation of the epithelial covering. The milder cases recovered very quickly. The corneal lesions showed no tendency to extend. The more severe cases were usually well within two weeks, or then only showed a slight photophobia and watering, which disappeared at the end of three weeks or a month. The reaction was always more severe when a bandage had been used on the eye.

Much more serious were the injuries produced by mustard gas (dichlorethylsulphide). This gas was first made by Victor Meyer in 1886. He described it as a heavy, oily fluid, sinking in water, and not miscible with it, of neutral reaction, having a faint sweetish ethereal odor slightly suggestive of the sulphur compounds, with a boiling point of 217° C. One of his laboratory workers engaged in making it developed skin eruptions with a transitory conjunctivitis. Meyer himself was not affected by it, and therefore concluded that individual susceptibilities vary greatly. He also concluded that injection of this compound could produce metastatic lesions.

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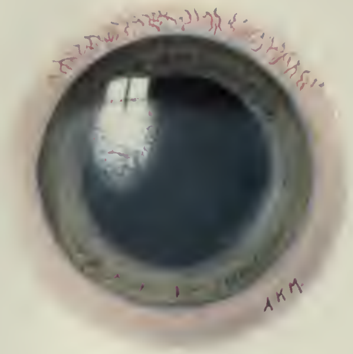
[1] Read at meeting of American Ophthalmological Society, Atlantic City, June, 1919.

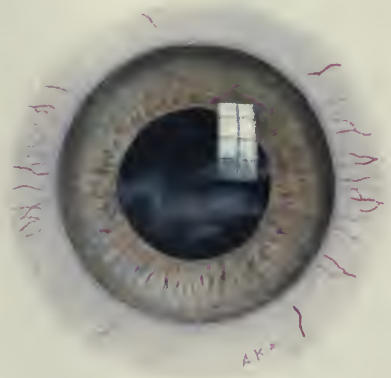
Mustard gas was sent over in shells, the so-called yellow cross-shells. It was first used extensively at Ypres on July 12–13, 1917. Mustard gas causes sneezing, followed by increasing nose and throat irritation. There is painful irritation of the eyes and sometimes vomiting. The action is a delayed one, and takes place in from two to six hours, with increasing inflammation of the mucous membrane and the skin. Severe erythema of the skin develops, followed by blistering. The moist portions of the body are more severely affected. Respiratory symptoms develop, and in severe cases bronchitis and secondary pneumonia may be seen in thirty-six to forty-eight hours. Pneumonia is the most frequent cause of death.

All grades of mustard gas involvement of the eyes may be met with. They may be divided into slight, moderate, and severe. The slight cases form 75% or 80% of those affected. Often, in the mild cases the subjective symptoms are severe. The lids are held tightly closed. There is profuse lacrimation and a considerable degree of injection of the conjunctiva.

In those more severely affected, the lids always show a considerable amount of redness and swelling and often the formation of numerous bullæ. The lid margins are sometimes excoriated. The lids are held closely pressed together, and any attempt to separate them is accompanied by severe pain, so that often it is necessary to use one or two drops of cocaine and employ a lid elevator in order to get a good view of the conjunctiva and cornea. The conjunctiva is markedly injected throughout, and may show a considerable degree of chemosis, which is most marked in the upper and lower conjunctival folds, which may project beyond the lids. Often the injection is of the distinct ciliary type. The region of the palpe-



Drawing of the cornea in the acute stage of severe burning.



Drawing of cornea in the stage of resolution after severe burning.

bral fissure is the most severely affected. In severely burned cases there is often an area of solid white œdema of the conjunctiva in the palpebral fissure, which presents a very striking appearance.

The corneal lesions are also of varying severity. In the milder cases there is only a very slight roughening of the corneal epithelium, which may or may not stain with fluorescein. In the moderately severe cases, there is a marked roughening of the epithelium with irregular grayish areas of opacity scattered throughout the cornea. Our British colleagues liken the appearance of the cornea in these cases to that of an orange skin. The area of the palpebral fissure always shows the most marked changes.

In the most severe cases a very saturated gray band is seen traversing the cornea in the area of the palpebral fissure, and this band is sometimes of almost porcelain whiteness. The roughening of the cornea is due to œdema of the epithelium and later on to exfoliation. Where corneal involvement is marked, fluorescein staining takes place.

Secondary conjunctivitis, especially when the eyes have been bandaged, is prone to develop; and secondary infection of the cornea may take place and may result in ulceration, and later even panophthalmitis and a loss of the eye. Luckily, such cases are comparatively rare.

The British Consultants have observed only about ten cases of corneal ulceration where impairment of vision was left behind. In four cases, panophthalmitis developed and the eye was eventually removed. Among 1500 cases, Teulières (2) saw one case of panophthalmitis and three cases of ulceration of the cornea. During the eighteen months preceding the armistice, about ten cases of corneal ulceration came under my observation—two of these were seen while serving with the British, but none of these were under my actual care, although many hundreds of gassed men passed through the hands of the hospital unit I was serving with at that time. A number of damaged eyes were seen while serving with the American Expeditionary Forces. One unfortunate was well on the road to losing both his eyes, largely, I believe, due to bandaging and to the lack of proper care. One case was seen where apparently no secondary infection of any severity had taken place, and yet, marked opacity of the cornea was present after many weeks which promised to be permanent. I call to mind another case where, after the process had almost entirely resolved and the cornea was bright and clear, a secondary ulceration developed of a severe nature, apparently due to a lowered vitality of the tissue. Ring abscess of the cornea has been noted by several British observers.

The lesions of mustard gas are in the nature of a chemical burn of the tissues of the eye. Warthin likens it more especially to the effect produced by hydrochloric acid. Pissarello (3) has exceptionally seen cicatricial ectropion following burns from mustard gas. Lister says that occasionally the actual liquid from the yellow cross-shell passes into the eye. The lesion then is similar to that produced by burns from other liquid caustics, and necrosis, ulceration of opposed surfaces, and symblepharon may occur. Personally, I have not seen such cases.

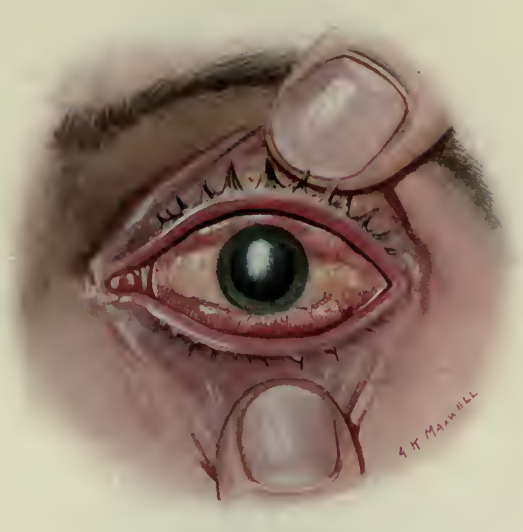
Teulières and Valois (4) describe slight iritis, cloudiness of the papilla, slaty tint of the retina, and congestion of the retinal veins. They describe this as a benign neuroretinitis. One may see a questionable hyperemia of the disk and retina, but it is altogether unlikely that disease of the posterior half of the eyeball following exposure to mustard gas occurs.

Cèrise, in his report to the French Ophthalmological Society in March, 1918, divides the cases into three groups:

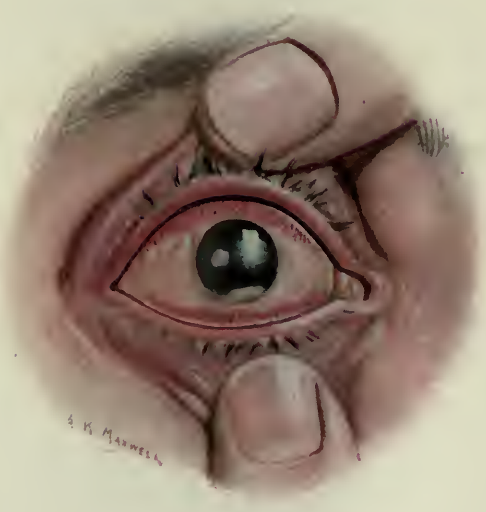
1. Benign, representing ten to fifteen per cent. of cases. Duration ten to fifteen days.
2. Medium, about 80% of cases. Duration five to six weeks.
3. Severe, three to five per cent. of cases; with marked general symptoms, often developing a broncho-pneumonia.

In our experience and in that of our British colleagues, the mild cases form a much larger percentage. In the first place, there are a very large number of mild cases of gassing which are never sent back to the hospital.

In the mild cases which reach the hospitals, recovery is rapid, and they may usually be sent back to duty in from one to two weeks. The moderately severe cases may have a duration of four weeks to two months and even longer. The conjunctival chemosis subsides fairly quickly. The white



Severely burned eye in the acute stage.



Slightly later stage of acute burning.

areas of œdema often take one to two weeks to disappear, and are replaced by an intensely red area. Colonel Lister calls attention to a peculiar mauve tint seen in these cases similar to that seen in certain cases of episcleritis. It may be two to four months before the most severe cases may be returned to duty.

Patients subject to chronic conjunctivitis and blepharitis often have their old condition lighted up by gas, and are then very resistant to treatment. Certain individuals develop a neurotic condition following exposure to gas. It is characterized by lacrimation and photophobia. This is probably due, at least in part, to the strong nervous impression produced upon the man by the severe irritation of the eye which the gas causes. He fears that he is about to become blind. Moreover, his general condition has often been impaired. Unless he is properly handled at this time, his convalescence is apt to be much prolonged, and certain of these men develop into malingerers.

TREATMENT.

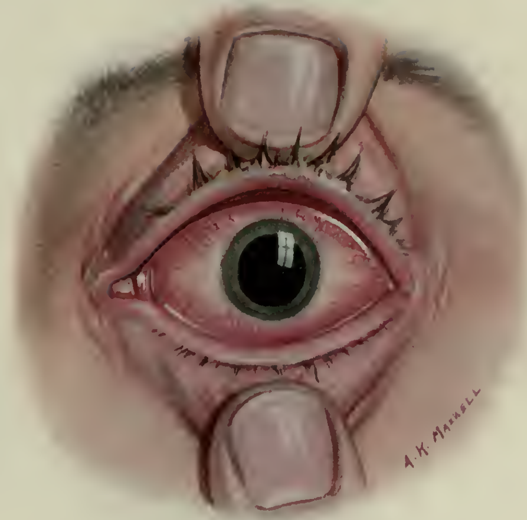
The gas mask when worn protects the wearer against the effects of mustard gas in the eyes and also in the respiratory passages. Naturally, it does not protect against skin lesions. When the soldier receives his first bathing after exposure to mustard gas, the eyes should be thoroughly washed out. As good a solution as any is sodium bicarbonate, and this was used as a routine in our gas hospitals, of which we had several in the areas back of the Argonne. In the later stages, when the soldier is sent back to the Evacuation or the Base Hospital, frequent bathing should be given with a lukewarm solution either of boric acid, salt solution or 1% sodium bicarbonate. Following this, a drop of oil should be instilled into the eye. The oil which we found the least irritating was liquid albolene. Theoretically, a vegetable oil, such as castor oil, should prove to be of value, as it dissolves the mustard gas. In practice, however, we found it rather more irritating than the liquid albolene and gave it up. For the milder cases, this treatment will suffice.

When, however, there is much blepharospasm and irritation, atropine should be always used, for this indicates a greater or less involvement of the cornea. If a one per cent. solution of atropine is used once or twice a day, it will usually keep the pupil well dilated. Occasionally, however, one must use it in larger amounts. A shade should always be supplied or a pair of dark glasses. The eyes should never be bandaged. Agreement on this point is unanimous. In the British Service and in our own, a great deal of trouble was experienced from the bandaging of these cases. In a number of cases where secondary infection of the cornea took place and the vision was permanently impaired, or the eye was even lost, we felt very strongly that bandaging contributed materially, if not entirely, to the bad results. Our experience is borne out by Warthin's experiments.

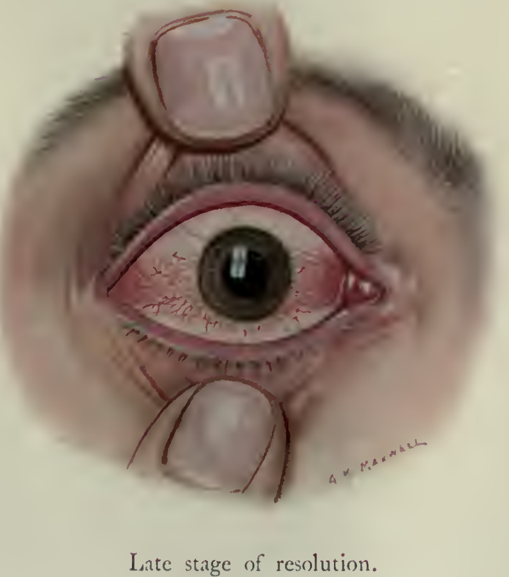
In those cases where secondary infection of the conjunctival sac took place, a weak antiseptic solution was found to be of benefit. Most often we used argyrol or protargol. If an actual septic ulcer of the cornea developed, it was treated by the methods used in civil life. As the nutrition of the cornea is impaired, it is well to apply heat when corneal ulceration occurs. The ulcer may be lightly touched with pure carbolic acid, and if necessary a Sæmisch section may be made.

Atropine should be continued so long as any corneal involvement in gas cases continues, and a shade or dark glasses should be worn as long as the pupil is dilated. As soon, however, as the pupil has resumed its normal size and the injection has largely disappeared, the patient, if his general condition permits, should be gotten out of his bed and should be sent outdoors into the light, and stimulating treatment should be applied if subjective photophobia and lacrimation still persist. Cold bathing of the eyes seems to be of value and a weak solution of sulphate of zinc twice a day. It is always wise to give the patient in this stage some sort of light duty. One should be always on the watch to combat the beginning of a neurasthenic tendency. These patients always recover with normal vision, unless a severe involvement of the cornea has taken place. In the treatment of gassed eyes cocaine should not be used, as it tends to damage further the corneal epithelium.

Reference has been made to a large series of cases seen while serving with the British Expeditionary Forces in which, to our knowledge, no permanent damage of the eyes took place.



Stage of resolution after severe burning.



Late stage of resolution.

This may be laid to several factors. In the first place, we got our cases early, being little over fifty miles from the front, and British transportation after three years of war had become wonderfully organized. Secondly, the eyes received immediate attention on reaching us, and treatment was faithfully carried out by an exceptionally strong and experienced nursing staff. The natural deduction is, and in this our British colleagues agree, that with proper handling of cases mustard gas should very rarely cause permanent visual damage. The majority of gassed cases tend toward spontaneous early and complete recovery. Visual damage is seldom seen, and complete blindness must be one of the very rare results of the war.

PATHOLOGY.

In the American Expeditionary Forces up to the time of the armistice, we had no provision for the pathological examination of eyes, though this was planned and would have been instituted had the war gone on. The British were more fortunate, for, although they did not succeed in obtaining material from those cases that died in the first few days after being severely gassed, they succeeded in obtaining eyes gassed a fortnight or so before; and I may be permitted, therefore, to quote from one of Colonel Lister's reports:

"The pathological examination of eyes which have been gassed show changes in the corneal epithelium, the substantia propria, and in the conjunctiva. Sections of the cornea show definite changes in the epithelial layer. The deeper cells, instead of being columnar, are flattened. The thickness of the whole layer is diminished, so in passing from the periphery toward the center of the cornea it gradually thins down till only a single layer of flattened cells is left, while in parts this also is lost and Bowman's membrane is left bare. The substantia propria in some cases shows infiltration of round cells between the layers, as is found in other cases of deep inflammation. In the conjunctiva over the sclerotic, granular masses have been seen in the subepithelial tissue, which probably correspond with the solid white exudate seen in the interpalpebral aperture."

At the close of hostilities, the American Expeditionary

Forces were fairly well equipped to care for gassed eyes. The medical officers at the various gas hospitals were sufficiently acquainted with the lesions which could occur to be able to give those cases proper treatment. At most of the mobile and evacuation hospitals, there was a trained ophthalmologist who had either had some personal experience in the treatment of gas, or who had been instructed in that work by personal visits from the consultants and by means of circulars which were sent around from time to time. The same also applied to practically all of our base hospitals in France. Bandaging of the eyes was strenuously combated. Medical officers and the medical personnel on hospital trains should also be instructed in this work.

When gassed cases are evacuated at base hospitals to convalescent camps, it is important that they should be grouped at places under trained medical supervision, in order that those cases with irritable conjunctivæ should be brought into condition to be sent back to duty at the earliest possible moment. Some of these cases may be held almost for a month under supervision, when with proper treatment they could be sent back to duty in a comparatively short time.

EXPERIMENTAL WORK ON MUSTARD GAS.

In this country recently a series of very important observations on the effects of mustard gas on the eyes of animals have been made by Warthin and various others. In these experiments, mustard gas was applied directly to the center of the cornea with a fine pipette and in uniform minute droplets. In another series, animals were exposed to the vapor of mustard gas in varying concentrations and time. These experiments were carried out mostly on dogs and rabbits.

Exposure of fifteen minutes to a concentration of 1:20,000 was found to cause a burn of the same severity as from a standard droplet applied to the center of the cornea. Fifteen minutes after the mustard gas was applied, congestion of the superior palpebral conjunctiva was noted. In one hour the conjunctiva had become œdematous. From then on, there was progressive increase in the œdema until there was a ring of swollen conjunctiva about the cornea.

ILLUSTRATING DR. DERBY'S ARTICLE ON "OCULAR MANIFESTATIONS FOLLOWING EXPOSURE TO VARIOUS TYPES OF POISONOUS GASES."

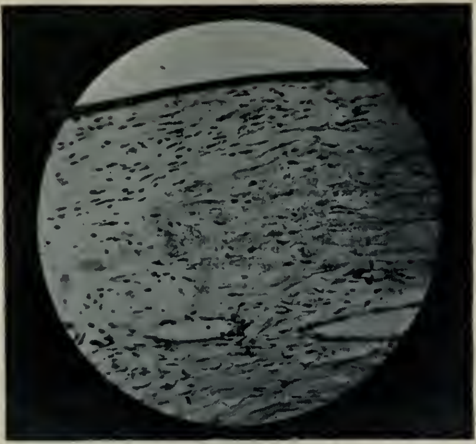


FIG. 1.
Granular exudate beneath bulbar conjunctiva, probably corresponding to solid white exudate.

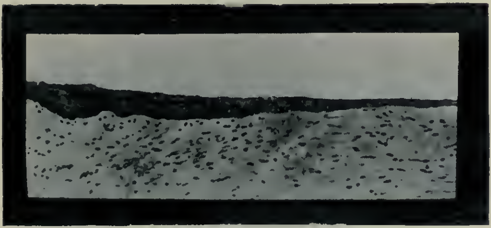


FIG. 2.
Corneal epithelium diminished in thickness. Cells are contracted and stain deeply.

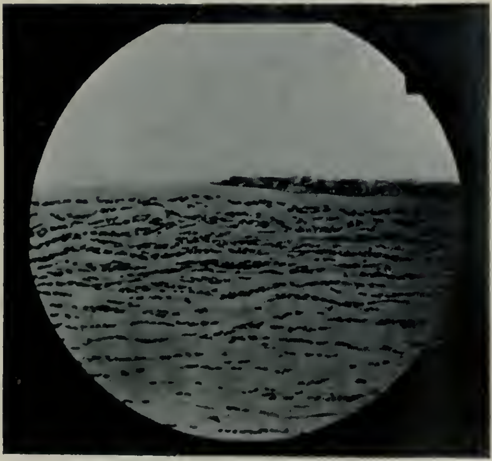


FIG. 3.
Thinning of corneal epithelium. Bowman's membrane laid bare, cellular exudate in the substantia propria.

Sections of Gassed Eyes Kindly Loaned by
COL. W. T. LISTER, R. A. M. C.

Corneal changes took place in five to six hours. They consisted first in faint clouding, roughening, and irregularity. There was an increasing seropurulent exudate. Photophobia and lacrimation were marked.

In eight hours, the cornea became porcelain white and there were irregular rounded areas without epithelium. Minute subconjunctival hemorrhages were seen. By the second day, the œdema was marked. The denuded area of the cornea increased in size, and there was a large opacity in the lower half of the cornea, which often showed an opaque band running horizontally. The lids were sealed by secretion. Hypopyon was sometimes seen.

During the second week, the exudate decreased somewhat, but the corneal opacity remained unchanged. The lids, however, became unsealed.

During the third week, the lesions were slowly progressive, but a sluggish reparative process began. Ectropion of the lower lid was noted.

In the artificially produced burns from mustard gas, Warthin found that the changes varied enormously according as to whether the conditions were treated or left untreated. If no treatment were given, the lids sealed and exudate accumulated. Purulent panophthalmitis often developed within three weeks, and within six weeks the eyes may be destroyed. If a larger dosage is used and the eyes remain untreated, panophthalmitis may develop more quickly. Panophthalmitis was due entirely to secondary infection, which occurred after several weeks in untreated cases even after slight gassing, and much more rapidly after heavier doses. Warthin found that staining with fluorescein took place very early after the application of mustard gas to the cornea. These observations show conclusively the damage which may be done by the bandaging of the eye.

A large number of eyes were examined microscopically. The earliest changes noted in the cornea consisted of pyknosis, contraction of the epithelium and of the substantia propria, most marked at the corneal vertex extending down to Descemet's membrane. This is followed by a loss of nuclei until by the twelfth hour the corneal vertex shows complete necrosis, the necrosis often extending from the limbus nearly to the scleral junction. Desquamation of the dead corneal epithelium begins in about five hours. Polynuclear infiltration of the sclerocorneal junction begins in five to six hours. The earliest signs of regeneration of the substantia propria of the cornea were noted at the end of sixty-five hours. The new formation of blood-vessels into the limbus was well marked at the seventh day. Slow repair of the cornea continued for several weeks with development of a highly vascularized corneal cicatrix. Marked changes in the corneal thickness occur as the result of separation of the lamellæ, œdema, cellular infiltration, and fibroblastic proliferation. The severity of the corneal lesion is in direct proportion to the concentration of the gas and the period of exposure. The necrosis of the conjunctiva is less in degree than that of the cornea or the skin surfaces of the eyelids. The primary necrosis rarely extends beneath the basement membrane of the palpebral and bulbar conjunctiva, except at the palpebral margin. There were shallow ulcers at the palpebral margin. There was extreme œdema of the subconjunctival connective tissue, most marked in the bulbar conjunctiva near the scleral sulcus and in the palpebral conjunctiva of the upper lid. Petechial hemorrhages were of frequent occurrence in the subconjunctival connective tissue. Regeneration of the conjunctiva takes place rapidly and is followed by permanent thickening. Iritis and iridocyclitis are common occurrences at about the third to sixth week in the uncared-for cases as the result of secondary infection. In the cared-for cases, no changes were observed in the iris, ciliary body, choroid, retina, and optic nerve except congestion and œdema. There was increased functional activity of the lacrimal gland, with subsequent overuse atrophy and subsequent hypertrophy. Warthin regards the relatively slight penetration into the subconjunctival tissues as due to the protection afforded by the moistness of the surface and lacrimation.

For treatment Warthin recommends a one half of one per cent. solution of dichloramin-T in chlorcosane. His experiments show that this solution if applied to the eye before exposure has a definite prophylactic action, and when applied to the eyes before and after exposure the resulting lesions are much less severe. Its use is indicated after exposure to gas for its germicidal action and the prevention of secondary infection.

Warthin concludes that the action of mustard gas on the conjunctiva is essentially the same as that on the skin. The conjunctiva is less susceptible to its action. Even in the milder cases of conjunctivitis, localized roughness or irregularity in the conjunctival surface may persist for weeks as the result of localized œdema, hyperæmia, and cellular infiltration.

As was mentioned before, Victor Meyer stated that he had produced a metastatic conjunctivitis from the injection of mustard gas. This statement was confirmed by Haldane. In an attempt to verify these statements, Warthin experimented on eight animals. In none of them did conjunctivitis develop.

Great difference in individual susceptibility has been found by a number of observers. It was tested by Marshall, Lynch, Smith, and Williams, of the Medical Division of the Chemical Warfare Service. They found a decided individual difference in the skin reaction to mustard gas independent of changes in sensitivity due to sweating. About 20 to 40% of the white men tested showed a certain degree of resistance; while 78% of negroes tested showed a similar resistance. About 2% of white individuals showed a hypersensitivity; no hypersensitive cases were found among negroes. Individual differences in sensitivity were also noted in animals. It is not improbable that the hypersensitivity to mustard gas may occur in those cases which show the picture of a persistent thymus and characteristic lymphoid hyperplasia.

My thanks are due to Col. W. T. Lister, C. M. G., Ophthalmic Consultant B. E. F., for very kindly sending me his "Report on the Effects on the Eyes of Irritant Gases Used in Warfare," also for the Atlas on Gas Poisoning prepared by the Medical Research Committee, and for various histological specimens of gassed eyes.

REFERENCES.

1. Gremeaux. *Progrès Medical*, 1916, p. 157.
2. Teulières. *Journal de Médecine de Bordeaux*, Nov., 1917, Feb., 1918.

3. Pissarello. *Giornale di Medicina Militara*, 1918, lxvii., p. 128. Cited by Warthin.

4. Teulières et Valois. Cited by Warthin.

5. Warthin, Weller, and Hermann. *Journal of Lab. and Clin. Med.*, vol. iv., No. 1, October, 1918.

6. Warthin and Weller. *Journal of Lab. and Clin. Med.*, vol. iii., No. 8, May, 1918.

A NEW OPERATION FOR GLAUCOMA INVOLVING A NEW PRINCIPLE IN THE ÆTIOLOGY AND TREATMENT OF CHRONIC PRIMARY GLAUCOMA.

By E. J. CURRAN, M.D., D.Oph. (Oxon.)
Professor of Ophthalmology, University of Kansas.

(*With one illustration on Text-Plate XI. and seven illustrations in the text.*)

IN this report of a new operation for glaucoma, it is well to review briefly the principles on which all former operations for the relief of this condition are based, in order to better appreciate the new principle on which this one depends, and to recount the observations and experiment which led to its adoption.

All former operations have had the object in view of one or several of the following:

(*A*) Drainage through the canal of Schlemm by exposing a large area by iridectomy well out to the attachment of the iris, or in the theory that the cut edge of the iris allows the aqueous to filter into it and thereby come into closer contact with the capillaries and be taken up by the blood stream, thus relieving the canal of Schlemm.

In the attempt to explain the undoubted benefit which iridectomy without a filtering scar sometimes gives, these two principles are the only ones worthy of notice advanced up to the present time. I shall endeavor to prove later that they are not the chief ways in which iridectomy gives relief.

(*B*) The failure of many iridectomies led some surgeons to seek purposely drainage through the sclera into the subconjunctival spaces, either (1), through iridectomy with filtering scar; (2) sclerotomy, or (3) both combined, or (4) with seton, by (5) sclerectomy alone or combined with iridectomy, buttonhole or complete, and (6) by including the iris in the wound (iridotasis). It is unnecessary to enumerate the various operations which have the principle of drainage through the sclera in view.

(*C*) Drainage into the subchoroidal spaces posteriorly by puncture of the sclera in the ciliary region, or by freeing the ciliary body to connect the anterior chamber with the subchoroidal spaces by breaking through the pectinate ligaments as in Furgus's operation. Both of these operations relieve the intraocular pressure, but result is not permanent.

It is unnecessary for one to point out that each and all of these procedures are attended with grave dangers, nor are they, even when successfully performed, the proper ones to select in most cases. No one is justified in taking a greater risk when a lesser one may be successful, especially if it will not add to the danger of relieving the pressure with the greater risk later in case of failure.

My operation differs from all others in the fact that it is an attempt to drain from the posterior chamber into the anterior chamber. It is not only a difference in procedure, but a difference in principle, and therefore, if successful, a distinct advance in our knowledge and treatment of chronic primary glaucoma.

Normally the aqueous passes through the pupil from the posterior to the anterior chamber, but it is here contended that in glaucoma this passage is impeded on account of the iris hugging the lens over too great a surface extent. Some of the aqueous gets through while some passes back, forcing the lens and the iris still more forward.

For the past three years I have been advocating in class and elsewhere, that the operation that counted most was that which gave drainage from the posterior to the anterior chamber. Some time ago I established the fact that if this could be obtained the canal of Schlemm could, in most cases, take care of the fluid which got into the anterior chamber. I have succeeded in doing this in several ways and with good results. I shall here give a brief report of some of the observations which led to that conclusion:

1. Three years ago I saw a case of glaucoma which was operated on forty years ago by iridectomy in both eyes with perfect success, in which there was no filtering scar, and also there was no inclusion of either root of the pillars of the coloboma in the wound. The patient had senile cataract in both eyes. The opacity was central with a few riders from the periphery and a great deal of clear cortex. The outline of the lens could be seen well. There were no adhesions of the iris to the lens; but the iris lay closely on the lens over a great surface extent and only left the lens at the extreme periphery, and it was easily seen that the only way in which the aqueous could pass to the anterior chamber was through the opening made in the iris by the iridectomy. This could happen only at the periphery of the iridectomy. The anterior chamber was a little less than normal. If there had been the slightest adhesion of the root of the pillars of the coloboma in the wound it would prevent the proper opening of the filtering angle and the wonderful success in this case would not have been achieved. There was no intraocular pressure in either eye, and the result of the operation was $\frac{20}{20}$ with corrective glasses. She was operated on for the glaucoma in Springfield, Illinois, and was unable to recall the name of the surgeon. It is sufficient for me to say that I took particular pains to assure myself that his diagnosis had been correct and that it was a case of primary chronic glaucoma.

It is widely held that all the benefit from iridectomy comes from the fact that in these cases there is a filtering scar. I admit that many operations of iridectomy for glaucoma would be failures were it not that fortunately a filtering scar was inadvertently or purposely made. But there was no filtering scar in this case, and it disproves, as do many other cases which I have observed, the necessity of the filtering scar in operative cure of early glaucoma. Other observations were made on successful iridectomies for glaucoma, and where there was no filtering scar they gave drainage into the anterior chamber. Where there was a filtering scar the anterior chamber was less deep and the results were not so good, excepting in old cases in which, no doubt, there were adhesions all around the periphery of the iris shutting off the filtering angle. Of course in such cases filtration through the sclera is necessary and an iridectomy without it would be useless. If we carefully observe the lens through the peripheral iridectomy in an Elliot operation we find the iris hugging it to almost the extreme periphery. This observation must be made when the anterior chamber fills and has remained normal for several weeks as the lens always comes forward immediately after the operation and remains so for some days or even weeks. It will be seen that at this time the filtering bleb becomes more circumscribed and more localized, so that it would be impossible to demonstrate that there was much if any filtration from the bleb and it partakes of the nature of a small staphyloma, no doubt capable of distending during temporary increase of intraocular pressure. If an examination of the contour of the iris is made in unoperated glaucoma one cannot fail to see that the bulging of the iris is the same as the anterior surface of the lens and this too can be followed far out toward the periphery, excepting in some eyes in which the cornea is very small, and in these it takes but little to impede the flow of the aqueous through the pupil, as in the eyes of negroes. In some cases the movement of the iris to light can be seen to be impeded by the lens, and the amount of surface extent hugging the lens can be determined. The movement of the iris and the apparent bulging of the lens should be weighed carefully and compared with that of normal eyes. In the study of this phase iridectomies done as a preliminary to cataract operations furnish much instruction. Some weeks should elapse after such iridectomy before we can get accurate data because the eye should, as in the cases above mentioned, become normal, especially in regard to the anterior chamber. It will be observed that in these eyes of normal intraocular pressure, the pillars of the coloboma do not rest on the lens, and but barely touch it only near the pupil. Of course, we are not now considering intumescent cataracts. These hug the lens to a greater surface extent than certain types of senile cataracts, and this is why we have a tendency to glaucoma in such cases. All these observations are made on living eyes much better than in pathological specimens, which are always altered in preparation either by shrinkage of the tissues or displacement of the structures, and can be verified from the practice of most ophthalmic surgeons.

In the light of these observations I concluded that most of the success in iridectomy, iridotasis, and sclerectomies with iridectomy depends on the fact that the drainage into the anterior chamber is often achieved by these operations, though, in such operations as the Elliot, in which there is free drainage into the subconjunctival tissue, the full use of the canal of Schlemm is not made unless the conjunctival bleb recedes or becomes circumscribed by adhesions, and the anterior chamber deepens without too long a delay. It was further concluded that where the filtering angle was closed permanently as it is in some cases in which there are adhesions of the iris, and in others in which there is a lack of proper development of the pectinate ligaments or the canal of Schlemm, it would be useless to drain into the anterior chamber. These classes of cases, however, notwithstanding any prevailing opinion to the contrary, I have found to be very few—much fewer than I had expected. They are amenable only to such operations as the Elliot or other scleral drainage. In September of 1916, I began with great caution to attempt drainage into the anterior chamber. Previously, I had been doing the Elliot operation and had so much success that I was reluctant to give it up even for a method which looked so promising and was much simpler. My first case was one of acute glaucoma. The iris and the lens were almost filling the anterior chamber and much of the periphery was apparently, though not, adherent to the back of the cornea. I made a five-millimeter incision of the cornea and iris together at the periphery, taking care not to injure the lens, with the result of a permanent fall of intraocular pressure, which has persisted ever since, and the patient has $\frac{20}{30}$ vision, which would probably be $\frac{20}{20}$ but for some corneal nebulæ. There were some adhesions of the iris at the pupillary border which I could not demonstrate all round the pupil, and at the same time I thought that there might have been some further back impeding the flow through the pupil, and therefore I had to consider this experiment open to doubt in regard to chronic primary glaucoma, although the other eye had been operated on by iridectomy some years previously with equal success by another surgeon. In this eye there was no filtering scar, and the iridectomy, of course, gave drainage into the anterior chamber. I did not select this case. It was thrust upon me on account of the acute attack, and I had to do it immediately at the home of the patient without any means of getting instruments to do any other operation. At that time I would not have selected such an operation for this case, though now it would be the first one to be tried. There was so much steaminess of the cornea that no adhesions could be made out until the eye was normal in intraocular pressure and the cornea became clear, but it was evident that they were old adhesions.

Following this I did six selected cases each of which had one eye very far advanced and the other with between $\frac{20}{30}$ and $\frac{20}{20}$ visions. In the very advanced eye I sought to obtain drainage by complete iridectomy, avoiding filtering scar, always leaving an area in which I could do an Elliot operation, should this fail, without the objectionable feature of having to dissect through the sclerotomy scar to split the cornea. In the better eye I made a five- or six-millimeter incision on the scleral side of the cornea-scleral junction, and inserted the iris forceps, drew out the periphery of the iris and cut a small piece off, making a small peripheral iridectomy which always appeared triangular in shape when replaced, as the accompanying picture of the largest peripheral iridectomy of the six will show (Fig. 1). All except two of the complete iridectomies were a perfect success in reducing intraocular pressure to normal. These two reduced it to such extent as to bring vision up, in one case from $\frac{20}{100}$ to $\frac{20}{50}$, and in the other, from hand movements to $\frac{20}{20}$. The hand movements were only in the extreme periphery of the temporal field; at the present time the nasal field, for a ten-millimeter disk of white, extends to thirty degrees, and the tension is 30*mm* of mercury by the Shiotz Gradle. Two months ago I made a small peripheral iridectomy in this eye, which reduces the tension to 23*mm* with a slightly deeper anterior chamber. The peripheral iridectomy in these six cases reduced the intraocular pressure to normal without exception, and the anterior chamber always became, and remained, deeper than in the complete iridectomies. The last of these was done in October, 1918, and the intraocular pressure has remained normal, and the vision undiminished to this time, and there seems no likelihood of a change. It is easy to replace the iris in peripheral iridectomies, and they heal without a filtering scar. They were more successful and better looking than the Elliot operation. They were done on very

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ILLUSTRATING DR. CURRAN'S ARTICLE ON "A NEW OPERATION FOR GLAUCOMA INVOLVING A NEW PRINCIPLE IN THE ÆTIOLOGY AND TREATMENT OF CHRONIC PRIMARY GLAUCOMA."

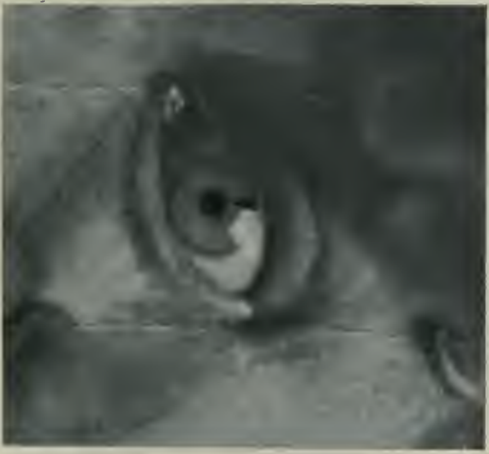

FIG. 1

early selected cases and I had to wait till time told its story. Consequently during these experiments, and for some time afterwards, I still continued to do the Elliot operation on most of my cases. I was not yet sure of my grounds until almost two years had elapsed from my first experiments, which was sufficient time to prove that drainage into the anterior chamber was of permanent benefit.

These operations of peripheral iridectomy were an improvement on any I have known except the recent development to be described in this paper, which I consider the simplest and safest of all operations for early chronic primary glaucoma and for some later stages of this disease.

OBSERVATIONS AND EXPERIMENTS ON A GLAUCOMATOUS RABBIT'S EYE.

Another incident happened which confirmed me in the belief that the chief mechanical cause of chronic primary glaucoma was a lack of proper drainage from the posterior to the anterior chamber. Dr. Major of the Department of Pathology had been experimenting with certain dyes on rabbits, and called my attention to the fact that a rabbit which had a fully developed cataract showed, when injected with eosin, the stain coming through the pupil into the anterior chamber. With the milky background of the cataract this could be seen beautifully. The illustration of the place of formation of the aqueous in the posterior chamber was so convincing that we had the rabbit injected several times for demonstration purposes some weeks apart. As time went on it was found that the stained aqueous would not come through the pupil until we shook the rabbit vigorously. This evidently displaced the lens and the stained aqueous would gush through. About this time the eye became hard, but shaking would reduce the intraocular pressure temporarily after the lapse of from fifteen to twenty minutes. Finally it could not be demonstrated at all, and the injections of eosin were neglected for six or eight weeks, the eye being hard when they were discontinued. After this time had elapsed another injection of eosin was made and it was found that the stained aqueous came through at one side of the lens in two distinct currents, side by side. A close examination was made and it was found that there were two small furrows in the lens on the anterior surface. The intraocular pressure was tried, and it was normal. Thus nature had reëstablished drainage into the anterior chamber, and the glaucoma was cured. The intraocular pressure had probably been normal from the first appearance of the furrows. Since the rabbit had been neglected for six weeks, one could not tell what time this reduction of intraocular pressure took place. This part of the experiment was done at a meeting of the Kansas City Eye, Ear, Nose, and Throat Club at the University of Kansas Medical School in October, 1918. Some cases cured by drainage into the anterior chamber by peripheral iridectomy were also shown at this meeting. The intraocular pressure of the rabbit's eye remained normal for three months afterwards. There was no iritis at any time in this eye and no adhesions of the iris to the capsule of the lens. It showed clearly that the lens does not have to enlarge much, nor does it have to come far forward in order to impede the aqueous flowing from the posterior to the anterior chamber through the pupil. It also goes to prove that what begins this mechanical condition is either an enlargement or a pushing forward of the lens, and once this is done ever so slightly we have a way in which it can be kept up by the back-wash of the aqueous, which would push the lens more forward. The closing of the filtering angle is a later development secondary to the events above mentioned.

With all this evidence in hand it might be supposed that one would try drainage into the anterior chamber in every case in which there were no absolute contraindications. This was not done for time must elapse before one can be certain of the permanent success of any operation for glaucoma, and during the last two years over one hundred and fifty Elliot operations with peripheral iridectomy were done partly because it was felt that both drainage into the anterior chamber and subconjunctival drainage could be obtained at the same time, making doubly sure of reduction of tension. This was a mistake, for the drainage through the sclera prevented the proper opening of the anterior chamber till later; and if this drainage happened to be too free it completely frustrated the good which should be achieved by the peripheral iridectomy, and left only the unnatural scleral drainage, which of course saved the eyes from blindness, even if in a crude manner. However, in the majority of cases I was pleased to see the bleb becoming circumscribed by adhesions, and take on the character and appearance of small staphyloma, and the anterior chamber deepen. Because of these observations I consider that this work had its instructive value, which was not lost. In my work with the Elliot operation I found the same great fault, but to a lesser degree, as with the wide iridectomy, the too sudden reduction of intraocular pressure, and the danger of either retinal or expulsion hemorrhages. The peripheral iridectomy above described, with a five-millimeter incision, reduced this danger, but still it was not entirely eliminated. It seemed to me that the smallest kind of a hole in the iris would be sufficient to give the required drainage. To do this without injuring the lens at first seemed a difficult matter. My study of the position of the lens *in vito* enabled me to select the position in the iris in which a puncture would be least likely to cause such an accident. I was fortified by the fact that I had cut through both cornea and iris in the case of acute glaucoma mentioned in the early part of this paper without injury to the lens and with perfect results. Consequently I determined to try simple perforation of the iris at the periphery. In order to find the easiest way in which to do this I selected five rabbits and using a Knapp needle knife tried various ways of making a small hole in the iris. I found this could be readily accomplished and the risk of injuring the lens much less than I had anticipated. I shall now report a series of cases in which this principle was carried out.

CASE I.—In March, 1919, I had a patient in the hospital on whom I had already done an Elliot operation on the right eye, which was almost blind for three years, and I explained to him the nature of the experiment which I wished to perform on his left eye, and he willingly consented to have it done. This man had a vision of $\frac{20}{30}$, and his temporal field was limited to thirty-five degrees. He was under eserine for two years, and it was producing a good deal of conjunctival and even lid irritation. The intraocular pressure under eserine was 35*mm* (McLean tonometer) of mercury most of the time while under this treatment, but, in spite of the fact that there were regular instillations of one drop of ½ of a 1% solution four times a day, there were rises of intraocular pressure, especially in the morning, which probably took place during sleep. The patient was prepared in the usual way with instillations of five per cent. cocaine, and an injection of 1% cocaine with adrenalin was made in the upper part of Tenon's capsule, so as to catch the ciliary nerves coming to the iris in order to render the puncture of the iris painless. A Knapp needle knife was passed edge upward through the cornea-scleral junction on the temporal side of the upper quadrant of the eye. As the point entered the anterior chamber it was directed upward and inward for five or six millimeters through the aqueous, and then depressed to engage the iris, pushing it forward into a small fold which makes the iris more easily punctured, without danger of injury to the lens. When the point was seen to make a counter puncture of the iris the knife was withdrawn, leaving two small black holes in the periphery of the iris, difficult to see with the naked eye. No aqueous was lost. The eye was closed, but no bandage applied, and the patient sent back to his room. Two hours afterwards the eye was harder than when the operation began, and the anterior chamber was deeper. There was no aqueous lost, and the cocaine had probably caused the temporary increase of intraocular pressure before the natural drainage had time to be reëstablished. The following day the tension was normal, and has remained between 32*mm* and 38*mm* (McLean tonometer) ever since, without any other treatment. The vision has increased to $\frac{20}{20}$ and the field is now almost normal. Ten days after the operation, when the wound had healed and the eye was perfectly quiet, it was put under homatropin for one day. The intraocular pressure was taken several times during that day and at nine o'clock next morning. At no time during this test did it rise above 35*mm*. When seen on the 4th of July, 1919, the intraocular pressure was 35*mm*, and on September 6, 1919, it was 38*mm*. It is well known that the intraocular pressure of the eye in glaucomatous patients varies under different degrees of emotion, or varying conditions of health, etc., and an occasional test would therefore be misleading. To avoid error on account of this, it is necessary to take the intraocular pressure in all cases, especially after operation, at least three times a day for a month afterwards, when it is possible.

Whether it is of scientific interest or not I shall mention that I had the experience of testing this man's intraocular pressure at a period of great anxiety, during which he stood to lose a great deal of money, having drilled an oil well which was apparently dry. I was with him at this time on the oil fields and probably was as much dejected as he was when we left that night thinking that the well was dry. Next day the well came in a gusher and his anxiety was turned to joy by the fact that he was made at least a half a million dollars richer during the night. The intraocular pressure was taken frequently during these days, and was never above normal. Thus anxiety and joy failed to produce intraocular pressure after the operation.

In this case the hole in the iris made by the counterpuncture as shown by Figure 2 is useless, because it is not sufficiently far out in the periphery, and rests on the lens; consequently all the drainage comes through the peripheral hole, which is no more than half a millimeter in size. The result, however, being perfect, it was decided to make only one peripheral hole in future, and in cases of later glaucoma to make it a little larger in case there should be any small hemorrhage to organize and close it up. It has been abundantly proved that iris tissue never proliferates in aseptic non-inflammatory and non-hemorrhagic wounds. So if there is no hemorrhage and no iritis we can be certain that the drainage will be permanent. Further experiments showed that in late glaucoma it was necessary to make a similar iridotomy in another part of the periphery of the iris, preferably directly opposite the first one, a week or so afterwards. I have had to do this only in three cases out of the eighteen eyes which I have operated on.

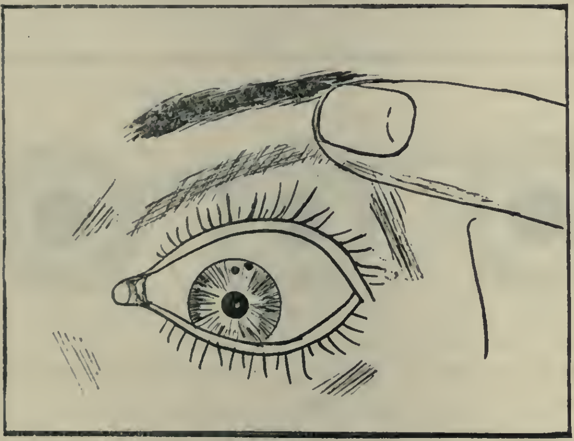

FIG. 2.

The plan adopted in the following operations is well illustrated by A, B, and C. Fig. 3. The knife was passed through at the cornea-scleral junction. The iris was engaged by the point of the knife which on further pushing formed a little ruck in the iris, rendering the easy performance of a counterpuncture. (Plate B shows the point of the knife coming out under the iris.) The knife was pushed still farther with pressure directed upward, so as to cut through the iris transversal, making a hole about 1*mm* in size. Sometimes it was necessary to almost make a counterpuncture in the cornea in order to sever the intervening piece of iris. At times it was found that the first puncture made a hole in the iris sufficiently large and the knife was withdrawn without a counterpuncture in the iris. In cases of long standing in which there might be an occlusion of the canal of Schlemm, the knife was directed toward the ligamenta pectinati of the opposite side so that some of these would be cut by the point of the knife with the hope that free drainage into the canal of Schlemm would thus take place.

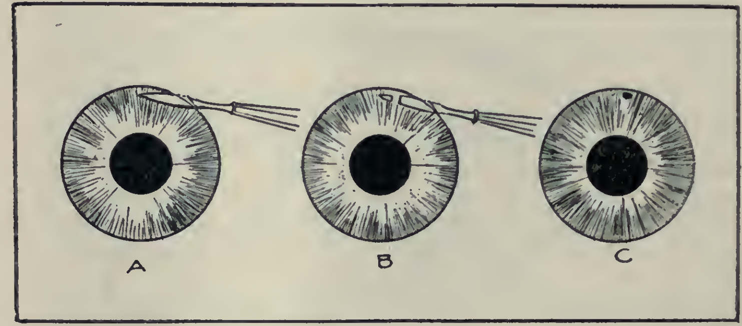

FIG. 3.

Fig. C shows the general appearance of the hole in the iris; after the operative wounds have healed, as will be seen by the picture of some of the other operations, this hole may differ in shape. Sometimes after the operation the pupil is slightly irregular, being flattened opposite the iridotomy.

I shall now give a very brief outline of cases operated on by this method. Only the salient points shall be mentioned, such as the depth of the anterior chamber, thickness of iris, activity of pupil, field of vision, and intraocular pressure, etc.

These cases must not be confused with the six cases of small peripheral iridectomy described in general in this paper, and pictured for the one particular case by the photograph (Fig. 1); nor the case of acute glaucoma previously described and operated on by iridotomy. The tension in all these cases in which it is recorded was taken by the McLean tonometer, which I have found to be the most satisfactory after comparison with other tonometers before adopting it. It must ever be kept in mind, when we consider the varying size of eyes and curvatures of the cornea, that those who are familiar with the laws of mechanics will not concede that any tonometer up to the present date will give an accurate conception of the intraocular pressure of the eye; but no one will agree that an intraocular pressure thus taken is not of some value. The effects of an increased intraocular pressure will not be so disastrous in one eye as they are in another. A great deal depends on the elasticity and thickness of the sclera, the arrangement of the fibers as they pass through the cribriform lamina, and the density and strength of the cribriform lamina in relation to the elasticity and thinness of the sclera. In short, trauma of the nerve fibers as they pass into the optic nerve at the lamina is the chief disastrous effect of glaucoma. It must also be constantly kept in mind that under ordinary circumstances an intraocular pressure of 40*mm* of mercury measured by the McLean tonometer would be about equal to 26*mm* measured by the Shiotz or Shiotz-Gradle tonometer, and would be about the upper limit of the normal intraocular pressure, that is, a pressure which with the normal cribriform lamina would produce no trauma to the nerve fibers. On the other hand, a pressure which is much below this normal might produce considerable damage to the nerve fiber if the lamina cribrosa were very weak, as it undoubtedly is in simple glaucoma. Again, if the vision of an eye remained comparatively good at 60 or 70*mm* by the McLean tonometer for a considerable time, it might well be considered that these nerve fibers which survived under this pressure for a long time would have a chance of surviving indefinitely if the intraocular pressure were reduced by operation or otherwise to 45 or 55*mm* of mercury.

The intraocular pressure alone is not sufficient whether it is measured by the McLean tonometer, as it is in these cases, or by any other tonometer. We must consider the results in vision and in the subjective symptoms in estimating the success in the treatment.

CASE 2.—Female—white; age 47. Came to the University of Kansas Eye Clinic, complaining of dimness of vision in the right eye and complete blindness in the left, which had existed for two years in this state. Never had any pain in either eye. Sight in left eye went out unnoticed by the patient.

Examination. Right eye: $\frac{20}{20}$, with slightly contracted field of vision on nasal side.

Left eye: No light perception.

Intraocular pressure: R. 45*mm* of mercury; L. 88*mm* of mercury.

Measurement of cornea: R. 11*mm;* L. 11*mm.*

Iris: Color brown, and moderately thick, slightly curved to contour of lens.

Pupils: Left was larger than right and normal reaction to light and accommodation.

Anterior chamber: Right: moderately shallow; Left: more shallow than R.

Right: After instillation of eserine, the intraocular pressure became normal and remained so while under the drug.

Left: Intraocular pressure was reduced to 50*mm* under eserine.

March 7th: An iridectomy was performed on the left eye and on August 6th, the intraocular pressure in this eye was 28*mm.* There is a small filtering scar.

March 24th: The right eye was operated on by a small iridotomy ¼*mm* in size, as shown by Fig. 4, and the intraocular pressure on April 16th was 25*mm.* No eserine was used and no other treatment since the operation.

April 29th: The patient was kept under homatropin 1% for one day, after which the intraocular pressure was found to be 32*mm* of mercury.

September 5th: The intraocular pressure by palpation was normal. No difference in depth of the anterior chamber was observed, and the patient was put under 1% homatropin at 12 o'clock three drops every hour, which was continued until four o'clock.

September 6th: When the intraocular pressure of the right eye was taken by the tonometer it registered 34*mm* of mercury. Two days of 1% homatropin instillations failed to raise the intraocular pressure and it was considered that this eye required no further treatment.

November 2d: The intraocular pressure was 35*mm;* the vision was unchanged and the eye had been comfortable in the interval.

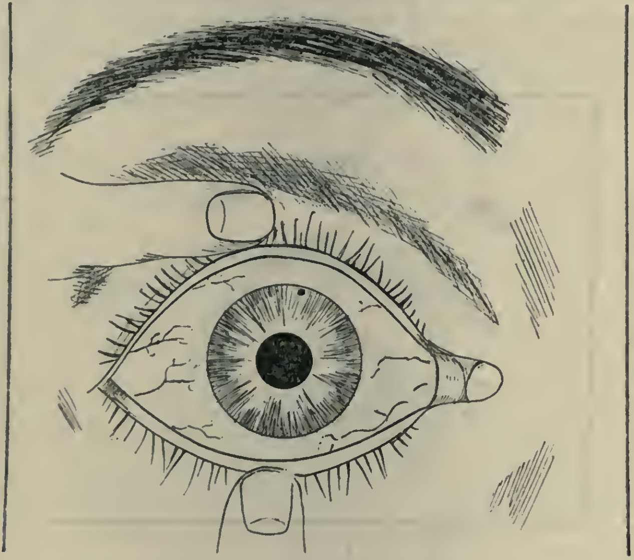

FIG. 4.

CASE 3.—Female, white. Under treatment for glaucoma in both eyes for two years; good response to eserine.

Vision: R. $\frac{20}{40}$; L. $\frac{20}{30}$.

Field of right eye contracted to 10° in the upper nasal segment quadrant, and to 30° in the temporal side. Field of left eye slightly contracted on the nasal side.

Intraocular pressure: R. 68*mm* of mercury; L. 67*mm* of mercury.

Cornea: 11*mm.*

Iris: Blue, and well marking the contour of the lens.

Anterior chamber: Shallow in right eye and less so in left eye.

Pupils: Active when not under eserine, but left more active than the right.

The eyes were doing well under ¼ of 1% eserine five times a day, and the patient went to her summer home in

Massachusetts at the end of May. June 2d her right eye became painful and red and she called me East to operate. On arrival the eye was found to be free from inflammation and the intraocular pressure normal; the eye of course was under eserine. A small iridotomy was done as shown by Fig. 5, which is a drawing showing results of operation in her eye. The operation was done in her own home and she was downstairs fifteen minutes afterwards, feeling no discomfort. The eye was normal in appearance and the anterior chamber deepened in a remarkable manner two days afterwards, and no further treatment was given the eye. Eight days after the operation this eye was kept under cocaine for two days with no rise of intraocular pressure. Previous to the operation holocaine or cocaine instillation would produce an immediate rise of intraocular pressure with pain. Fifteen days afterwards the eye was put under homatropin with the consent of the patient for one day, with no rise of intraocular pressure. The patient is now using eserine in the left eye, but nothing in the right eye, which is considered well up to this time. On October 1, 1919, the intraocular pressure was 37*mm* and on December 2, 1919, the pressure was 31*mm*. This patient has been under homatropin several times since September with no rise of pressure.

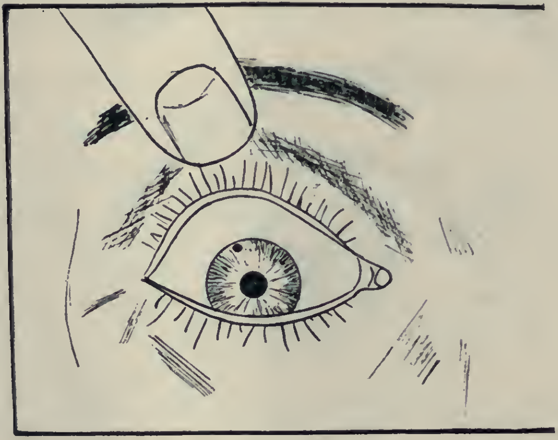

Fig. 5.

On Feb. 5th, 1920, the intraocular pressure was 35*mm*. No eserine was used since the operation.

Case 4.—Colored, age 56; right eye blind from glaucoma with no light perception for four months. Appeared at clinic May 28, 1919; dimness of vision in right eye began thirteen years ago. Right eye became blind two years ago with no light perception four months before. Left eye dimness eight years before which became much worse during the last year.

Vision: R. no light perception. L. $\frac{15}{30}$ with difficulty.

Intraocular pressure: R. 85; L. 70.

Lens changes both eyes. Fundus seen clearly.

Iris: Dark brown.

Pupils: Sluggish.

Anterior chamber: Very moderately shallow.

June 4, 1919: Small peripheral iridotomy done in upper part of the iris in both eyes, each about 1 ½*mm* in size.

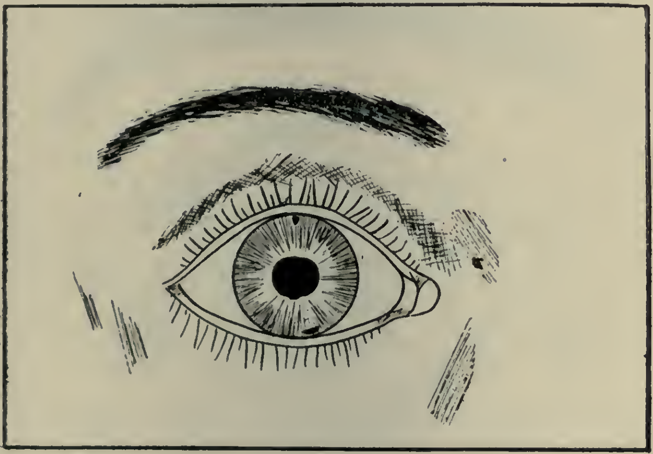

FIG. 6.

July 9, 1919: No treatment during the last five weeks. Intraocular pressure: R. 50; L. 37.

July 10, 1919: Intraocular pressure: R. 40; L. 37.

July 11th: The second operation of right eye on this day, small peripheral iridotomy as shown by picture in lower part of the iris.

July 14th: Intraocular pressure: R. 30; L. 40.

July 15th: Intraocular pressure: R. 39; L. 35.

July 18th: Intraocular pressure: R. 38; L. 38.

July 21st: Intraocular pressure: R. 30; L. 40.

July 23d: Intraocular pressure: R. 33; L. 31.

July 25th: Intraocular pressure: R. 35; L. 39.

July 28th: Intraocular pressure: R. 30; L. 40. Vision: R. No light perception. L. Two letters of $\frac{15}{15}$.

July 30th: Intraocular pressure: R. 32; L. 50.

July 30th: The second iridotomy in the lower segment of the iris of the left eye.

August 4th: Intraocular pressure: R. 32; L. 30.

August 6th: Intraocular pressure: R. 38; L. 34.

August 25th: Intraocular pressure: R. 38; L. 34.

August 30th: Intraocular pressure: R. 40; L. 37.

September 4th: Intraocular pressure: R. 45; L. 40.

September 6th: Intraocular pressure: R. 50; L. 40.

September 8th: Intraocular pressure: R. 53; L. 40. Vision: Right hand movements out in temporal field. Left $\frac{15}{30}$ with case and two letters of $\frac{15}{20}$. No eserine was used from the first operation.

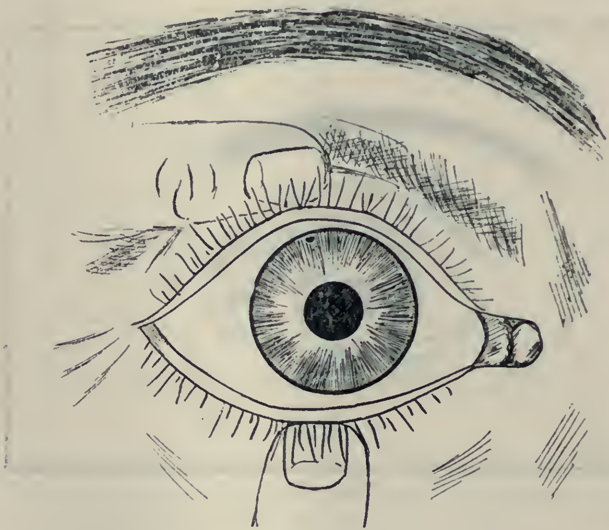

Fig. 7.

Case 5.—Female; colored, age 48. Came to the clinic complaining of failing vision (April 8th) which began six years before.

Intraocular pressure: R. 47; L. 72.

Cornea: 11½*mm.*

Iris: Brown, thick and slightly curved to the contour of the lens.

Anterior chamber: Shallow in both eyes.

Eyes responded to eserine poorly and on May 16th a small iridotomy was performed in the right eye as shown by picture Fig. 7, and a larger one in upper part of left eye as shown by picture Fig. 8.

April 30th: Intraocular pressure: R. 38; L. 42. Vision: R. $\frac{15}{15}$; L. $\frac{15}{20}$. Still complains of dimness of vision in left eye.

Another operation was done in the left eye making two small iridotomies as shown by Fig. 8.

June 1st: Intraocular pressure: R. 40; L. 32. Both eyes vision clear.

June 28th: Intraocular pressure: R. 40; L. 38. Vision: R. $\frac{15}{15}$; L. $\frac{15}{20}$.

No treatment has been given since the first operation. Patient passed from observation.

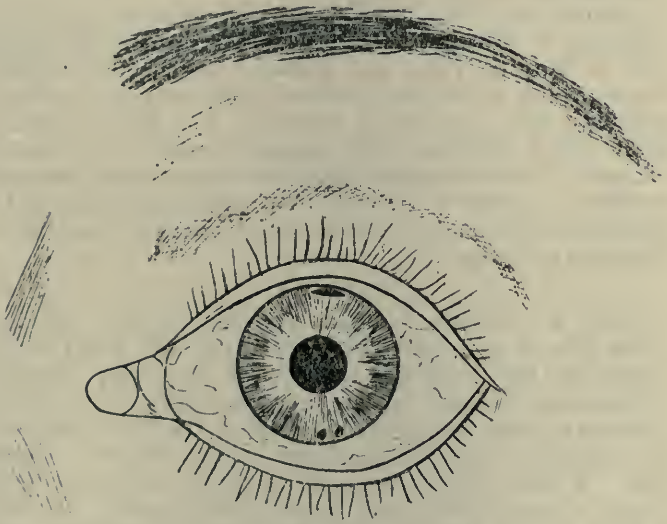

FIG. 8.

CASE 6.—Female, white, age 52. Came to clinic September 2, 1918. Iridectomy had been performed eighteen months before in left eye, at which time she could count eight meters away; left eye had previously been removed. Light perception and shadow movements in extreme periphery of temporal field in left eye. Intraocular pressure: 88.

September 12, 1919: An Elliot operation was done.

January 10, 1918: Intraocular pressure: 32.

March 6, 1919: Intraocular pressure: 40. Vision: Hand movements, increased light perception, slightly larger field. Can locate windows and doors in a room.

May 16, 1919: Intraocular pressure: 48.

A small iridotomy was done at the lower segment of iris and the intraocular pressure since that time has never risen above 38*mm* of mercury.

September 6th: Intraocular pressure: 38*mm* of mercury. Vision unchanged. The filtering bleb of the Elliot operation had become much smaller since the peripheral iridotomy. Last tension taken November 16, 1919, 38*mm*.

Case 7.—Female, white, age 55. Treated by Christian Science for glaucoma, when vision was good, for four years. Both eyes blind for two years. Appeared at the clinic in August, 1918. Intraocular pressure: R. 81; L. 89. Vision: Shadow movements in both eyes.

August 20, 1918: An Elliot operation done in both eyes. Intraocular pressure remained under normal throughout, and on May 30, 1919, was 30*mm* of mercury in both eyes. There was a rather large filtering bleb and with a view to reducing this a peripheral operation was done on left eye, after which filtering bleb began to recede in a marked manner. The intraocular pressure remained for about two months at 35*mm* of mercury, and patient has resumed her work as an actress, having sufficient vision to find her way about on the stage.

Case 8.—Female, colored, age 45; left eye. Came to clinic May 8, 1919, complaining of great pain in her left eye. Vision had been failing in this eye for two years. Examination showed vision doubtful light perception in extreme peripheral of temporal field. Œdema of the lids; chemosis of the conjunctiva and steaminess of the cornea. Tension 100. A small iridotomy 4*mm* long was performed in this eye on the same date and patient went home. There was a good deal of bleeding into the anterior chamber, which was filled with blood and eye was still hard when she left the operating table.

May 12th: Patient returned to clinic; cornea now clear; swelling of the eyelids and conjunctiva had partially subsided. There was a blood clot round the periphery of the anterior chamber, seemingly occluding ⅔ of the filtering angle. The intraocular pressure was 60*mm* of mercury. Patient was much relieved from pain but eye was still very tender. Patient did not return to clinic. On August 12, 1919, I visited her home. The eye was quiet. Vision had not improved and intraocular pressure by palpation was normal or 4 to 5*mm* above normal. Patient was disappointed at no improvement in vision, and while her eye remained comfortable after the operation she could not be induced to return to the clinic.

Case 9.—June 26, 1919, I was called to Independence, Mo., by Dr. Harris, to operate on a case of acute glaucoma. Patient was a female aged 72. I have not the past history to present. There had been great pain for several days, steaminess of the cornea, and shallowness of the anterior chamber.

Intraocular pressure: 65 (Shiotz-Gradle tonometer).

Vision: Hand movements.

Local anæsthesia had no effect and the patient was put under chloroform. A small iridotomy 4*mm* in length was performed and when the patient was seen three weeks afterwards the eye was quiet and the vision $\frac{10}{100}$. The tension by palpation was considered normal. I have not seen the patient since, but her oculist reports that she is doing well, with a normal intraocular pressure. Last report December 2, 1919.

Case 10.—Male, white, age 60. Came to clinic with absolute glaucoma in both eyes on January 26, 1919.

Intraocular pressure: R. eye 90; L. eye 100.

Right eye, slight œdema of the lids, and much inflammation of conjunctiva and eyeball. Left eye much œdema of lids, and great swelling of conjunctiva, much steaminess of the cornea, and great pain. He wished this eye removed. An Elliot operation was done in both eyes with 1*mm* trephine. Peripheral iridectomy was easily made on right eye; the eye became quiet, and nothing further needed to be done to it. Owing to smallness of trephine hole an iridectomy was not successful in the left eye, and although this eye was much improved the intraocular pressure remained about 60 until May 28, 1919, when a peripheral iridotomy 3*mm* in length was performed in this eye; the anterior chamber has deepened and intraocular pressure has remained at 50*mm* of mercury ever since. There is no pain in the eye, but there is still some pericorneal injection and August 28th there was, of course, still no light perception in the eye, but occasional light perception returned to the right. Up to December 2, 1919, the patient has not returned to the clinic.

Case 11.—Male, white; age 62, had been under treatment at my office for one year and a half for chronic primary glaucoma. Came back for observation March 20, 1919.

Vision: R. $\frac{20}{30}$; L. $\frac{21}{100}$, which was unchanged from beginning of the treatment. Eserine was omitted for two days, when the intraocular pressure was taken and found to be R. 50, L. 60.

An iridotomy was attempted on the left eye, and there was a good deal of bleeding, so much that it could not be seen whether a hole in the iris was made or not. The patient left the hospital immediately afterwards. As he could not be kept under observation he was cautioned to use the eserine in both eyes. On July 16th he returned. The eserine was omitted for one day, and on July 18th the intraocular pressure in this eye was 60. A careful examination was made, but no hole in the iris was detected. As the patient lived over three hundred miles away and could not remain in town over that day he was advised to continue use of eserine. An iridectomy will be performed later.

Case 12.—Male, white; age 56. Came to clinic June 15, 1919, complaining of dimness of vision in both eyes, which began five years previously. Patient was under treatment in the Department of Neurology for tabes dorsalis.

Vision: R. $\frac{15}{30}$; L. $\frac{15}{30}$. Field of vision much contracted on nasal side; much on temporal side in both eyes.

Intraocular pressure: R. 45; L. 56.

Cornea: 12*mm.*

Anterior chamber: Shallow.

Iris: Blue, thin, and showing the contour of the anterior curvature of the lens slightly. Pupils did not react to light, with slight reaction to distance. The patient was placed under eserine ½ of 1% three times a day, and on June 20th the intraocular pressure was unchanged. He was ordered to use the eserine every two hours and on June 30th intraocular pressure: R. 40; L. 50. This was not considered sufficiently reduced so that the patient was again put under eserine every two hours for two days, and on July 2d, the intraocular pressure still remained—R. 40; L. 50.

July 15th: Intraocular pressure: R. 39; L. 51. Iridotomy done on both eyes.

August 2d: Intraocular pressure: R. 39; L. 45. No eserine was used since July 2d.

September 2d: Intraocular pressure: R. 39; L. 46.

Vision: R. $\frac{20}{20}$; L. $\frac{20}{40}$. Field of vision in both eyes increased slightly. Patient appreciates that he can see much better than before the operation was done. One half of 1% eserine was used every two hours from September 6th with no alteration in intraocular pressure, although the pupils contract greatly under its use. Eserine failed to have any effect whatever in reducing pressure in this case either before or after the operation. Another small iridotomy was done in the left eye. The pressure, however, has been keeping up since October 16th. Preliminary fall after the operation was due to filtration through the puncture. It is now R.

40, L. 50. The operation is considered a failure in this patient.

CASE 13.—Female, colored; age 50. Came to clinic July 26th. Complained of slight dimness of vision in right eye and blindness in the left.

Vision: R. $\frac{20}{20}$. L. No light perception. Intraocular pressure: R. 42; L. 81.

3*mm* iridotomy was performed in the left eye and the patient went home immediately.

August 16th: Intraocular pressure: R. 40; L. 50.
September 6th: R. 40; L. 45.
September 12th: R. 30; L. 30.
September 17th: R. 25; L. 39.
September 19th: L. 42.
September 22d: L. 43.
September 24th: R. 35; L. 50.
September 29th: R. 35; L. 50.
October 15th: R. 33; L. 50.
October 20th: R. 30; L. 40.
October 31st: R. 35; L. 40.
November 3d: R. 30; L. 30.
No eserine was used in either eye. Vision unchanged.

CASE 14.—Office patient; male, white; age 53; first seen on August 16th.

Intraocular pressure: R. 85; L. 75.

Vision: R. $\frac{6}{100}$; L. No light perception.

Cornea: 11*mm*.

Lens: Posterior lens opacities.

Iris: Blue, thin; anterior chamber very shallow; pupils reacted slowly in light and distance. Field reduced to 20° on nasal side with cotton ball 5*cc* in diameter.

September 16th: Iridotomy done in both eyes 5*mm* long. The knife was sharp and a larger iridotomy than intended was performed and in each eye a few fibers of the iris became entangled in the wound, making a filtering scar in both eyes, a condition which was not intended.

August 10th: Intraocular pressure: R. 35*mm* of mercury; L. 45*mm* of mercury.

Vision: R. $\frac{12}{100}$; L. slight uncertain light perception on the nasal field. The anterior chamber did not deepen, owing to filtering scar, and this was considered unsatisfactory, though no doubt the intraocular pressure will be permanently decreased.

October 13, 1919: Tension: R. 52; L. 56.

November 13, 1919: Tension: R. 54; L. 60. Vision: R. $\frac{4}{100}$; L. no light perception. Anterior chamber still shallow.

Lens opacities increased. Field of vision increased to 30° on nasal side. Diminution of vision evidently due to lens opacities. No lens opacities at site of iridotomy and he can see better through this hole than through the pupil as the lens opacities are central.

December 15th: Cataract extraction right eye.

January 10th: Intraocular pressure: R. 30; L. 50.

February 17th: Intraocular pressure: R. 38; L. 52.

Vision in right eye $\frac{20}{100}$. Large stringy and network floating vitreous opacities.

CASE 15.—Office patient, male, age 53; white. First seen August 10, 1919.

Vision: R. $\frac{20}{30}$ with difficulty. L. $\frac{20}{40}$.

Intraocular pressure: R. 77; L. 80.

Iris: Blue, thin, and showing contour of anterior curves of lens moderately.

Anterior chamber: Moderately shallow.

Pupils: Sluggish.

August 16, 1919: Iridotomy attempted on right eye. Not sure of success. Iridotomy on left eye *2mm* in size. Patient kept in hospital for two days.

August 18th: Both eyes comfortable.

August 26th: Examination failed to reveal any hole in right iris.

Intraocular pressure: R. 30; L. 25. McLean tonometer.

August 30th: Intraocular pressure: R. 40; L. 30.

September 6th: Intraocular pressure: R. 40; L. 35. Left eye put under eserine.

September 10th: Intraocular pressure: R. 40; L. 35. Under eserine a minute hole was observed in the iris.

September 16th: Intraocular pressure: R. 40; L. 38.

It is probable that when the eserine is discarded, the small hole in the iris will not function so well, and a larger hole will be made in future, though even this may not be necessary. A very slight deepening of the anterior chamber was observed in both eyes. Since the above was written the following is the report continued.

October 28th: Tension: R. 45; L. 36. Vision: R. $\frac{20}{30}$; L. $\frac{20}{40}$.

November 21st: Tension: R. 55; L. 43. Vision unchanged. Evidently the filtering angle is not sufficiently open to drain these eyes.

In studying these cases it is necessary to consider the effects of puncture of the eye; if the puncture is made in the cornea, it is sealed in a few hours, and if there is no loss of aqueous the intraocular pressure will not immediately be reduced, but on the other hand may be slightly increased, owing to the instillation of cocaine for the operation. In such a case the fall of intraocular pressure will be noticed the next day, but if the puncture is made say 1*mm* from the clear corneal tissue on the scleral side, where it is more vascular, the sealing of the wound does not take place so readily, and even when the wound is healed and quiet, say after ten days, we must be suspicious of some filtration through this scar, which, however, gradually closes completely. In this manner we can account for the gradual increase in tension in some of the advanced cases above described. In an advanced case the anterior chamber with its filtering angle is not fully restored with the operation in such cases, so that the intraocular pressure, though very greatly reduced, is not reduced to normal. In the very early cases, however, the anterior chamber is fully restored, and the filtering angle can take care of the change of aqueous permanently when the filtering scar is firmly closed. It seems that even if a filtering scar were found necessary in the advanced cases it would be better to perform this operation first and get the anterior chamber as fully restored as the pathology of the case would allow. We can tell when the anterior chamber is thus restored to its fullest extent by watching the intraocular pressure rise gradually until it comes to a point where it remains permanent. If this is not too high an intraocular pressure and the field and vision keep constant, although the intraocular pressure is moderately high, it may be considered that the nerve fibers which have already been under very high intraocular pressure for a long time will function indefinitely; but of course the eyes must be kept under close observation. In early cases where the anterior chamber had been originally shallow and has been definitely restored to normal by the operation, no such constant observation is necessary.

THE THERAPEUTIC USE OF RADIUM IN DISEASES OF THE EYE.[1]

By HENRY H. JANEWAY, M.D., New York City.

ALTHOUGH the Memorial Hospital has been using radium for five years, the eye cases, which have been referred to it for treatment, have been few until the last year or so.

Our experience has been limited to:

7 cases of sarcoma
1 case of old keratitis
6 cases of glioma
3 cases of nævi of the eyelids
12 cases of vernal catarrh
1 case of epibulbar melanosarcoma
2 cases of epithelioma of the scleral conjunctiva
60 cases of epithelioma of the eyelids

SARCOMA

Of the seven cases of sarcoma four tumors were intraorbital sarcomas. Two of these intraorbital tumors treated earlier in our experience were not improved. One, however, treated recently and referred to us by Dr. Knapp has been much improved.

This patient is a child six years of age. Eight weeks before she came to us, a swelling developed in the orbit, appearing more prominent above the eye and to its inner side and displacing it downwards and outwards.

She received three treatments over the eye which produced a marked reduction, almost a complete disappearance of the growth. It recurred and removal of the eye was advised, in order to permit of treatment without filtration of the radium from within the cavity of the orbit. After removal of the eye this treatment was given on August 21, 1919. 47*mc* of unfiltered radium emanation were placed in the center of the orbital cavity for twenty-four hours. We have since heard that this child died late in December, 1919, of meningitis secondary to mastoiditis.

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[1] Read before Section on Ophthalmology, New York Academy of Medicine, November 19, 1919.

When last seen during this month there was no evidence of disease in the orbit though the inflammatory effect from the treatment was severe and had not disappeared.

Three patients with sarcoma, primary as far as could be ascertained, in the choroid have been treated.

One of these patients, an old lady 65 years of age, was referred to us by Dr. Denig. The diagnosis was made in February, 1915, but the patient postponed operation until November, 1918. Section confirmed the diagnosis. She was referred for treatment July 23, 1919. At that time she had a huge tumor filling the orbit and extending backwards beneath the skin of the temple for 5*cm*. The treatment produced only a very temporary improvement.

The second patient, a young man 31 years of age, developed his lesion fourteen months before applying for treatment. His eye was removed December 15, 1917, and treatment was begun at the Memorial Hospital, April 30, 1918. At that time the orbit was filled with a tumor mass which was continuous with a hemispherical firm smooth mass on the frontal bone three inches in diameter at its base. He received eight treatments between April 30, 1918, and April 30, 1919, which produced a considerable reduction in the size of the mass and continued improvement was reported on July 18, 1919. The improvement continued until February, 1920, when renewed activity of his disease manifested itself.

The third patient was a young lady with an early intraocular sarcoma of the choroid. She received treatment and subsequently enucleation was performed. Sections of the tumor showed no evidence of any effect produced on it by the radium treatment, the first of which had been given two months previously.

From our experience limited thus far to merely three choroidal sarcomas and four intraorbital sarcomas we may conclude that radium will produce a temporary improvement, though not a complete retrogression in advanced lesions.

This marked susceptibility, which the large recurrent growths have shown, indicates that cures may be expected in some cases, if the recurrences can be treated early. Moreover an early recurrent growth can be treated more effectively because of its accessibility to the use of buried emanation, a more powerful method of handling it than the surface application alone. Certainly every case operated upon should be given the benefit of one post therapeutic prophylactic treatment. As regards the treatment of early sarcoma of the uveal tract the evidence at hand does not support the view that radium should replace enucleation.

Enucleation has been followed by alleged good resuits in early sarcomas of the uveal tract. The average percentage of cures in thirteen reports is 40%. These percentages vary between 6 and 83%. Every variation exists according to the type of sarcoma and the stage of the operation. The high percentages of cures belong to the spindle cell sarcoma and to the stage before the coats of the eyeball have been perforated.

The anatomical structure of the eyeball more completely isolates a tumor in an early stage than do most regions of the body. Enucleation in an early stage, a stage easily diagnosed in the eye, is so successful that with our present knowledge it should be the method of choice in the treatment of sarcoma of the ciliary body or choroid. A possible exception may be made to certain sarcomas of the iris and to epibular sarcoma. A trial by radium within the limits, within which it is safe to postpone operation, is permissible in certain cases of sarcoma of the iris. In epibulbar sarcomas a number of good results have been reported from radium treatment. We have one patient with such a tumor, whom Dr. Weeks referred to us. She has received thus far but one treatment given several weeks ago and at present is doing well. These growths are frequently small when the patient applies for treatment and are very superficially situated so that they can be easily and thoroughly exposed to radium and a trial should be given it before the more radical method of operation is resorted to.

In sarcoma of the orbital cavity external to the eyeball radium plays a very much more important rôle. Our experience does not support the view that in these growths it will save the eye yet it encourages the belief that it will save the life of the patient. After a preliminary radium treatment, exenteration should be performed and afterwards a post-operative treatment by unfiltered radium placed by cotton support in the center of the orbital cavity.

1000*mc* hours is not too heavy a dose.

A severe reaction may follow but if the growth has not already metastasized the patient's life may be saved.

The following reports furnish some idea of the operative result alone in the sarcoma of the eye:

Griffith reports fourteen patients of forty operated on who were alive three to ten and one half years after operation—35%.

Martin reports 62% recoveries in thirty-five cases of sarcoma of the iris.

Of six traced patients subjected to simple iridectomy for sarcoma of the iris, Wood and Pusey report five patients free from recurrence for three or more years; and favorable results to date were obtained on fourteen other cases. Eighty-five per cent. of primary sarcoma of the orbit are unclassified as to origin.

Sterling reports thirteen of twenty-nine patients well after operation of whom four were operated on three years previously. Recurrence occurred in nine of ten cases in which a local removal alone was performed. Of sixteen patients in whom complete evisceration was done seven were free from recurrence at time of report. Three patients were untraced.

Fuchs collected from the literature 221 sarcomas of the choroid and twenty-three of the ciliary body; of these 6% were cured by operation. In addition to these he adds 23.53% of seventeen of his own cases.

Lawford and Collins report 103 cases of sarcoma of the uveal tract; of these seventy-nine cases were traced of which thirty-nine are still alive. Twenty or about 25% have passed the three-year limit. Of the forty patients who died, death certainly took place from metastases in twenty-six and probably in others. Local recurrences occurred seven times.

Marshall published later a report of the 103 cases originally reported by Lawford and Collins. In 1903 only six cases of the thirty-nine patients, well at the time of the first report, remained alive. Of the additional deaths nine were known to be due to recurrences and eleven most likely were. Seven of these deaths occurred after the three-year limit. These new figures change the percentages of recurrences to 58.62% from 32.9%. Marshall reports fifty-eight new cases. In fifty-six enucleation of the eye was done and in two others later an evisceration. Twenty-four patients are still alive and eleven after an interval of three years and over. Six of the whole fifty-eight cases died from recurrence (two of local recurrence) and twelve are untraced. Excluding these, death occurred from recurrence in 13.04%.

Freudenthal reports twenty-four cases of sarcoma: twenty-one enucleations were performed; three eviscerations of the orbit; six cases were known to have developed a local recurrence; four others distant metastases; six patients or 37.5% were free from evidence of recurrence three years after operation.

Hagen reports twenty-eight patients operated on for sarcoma of the choroid. Twenty-four of twenty-eight traced for three and one half years. Twelve are well. Two died from other causes twelve and twelve and one half years after operation, the percentages of cures being, therefore, 58%. The percentages of cures with other writers varies from 6–56%. No recurrent lesions developed in any patient operated on before the ocular coats had been perforated. Metastases occurred with few exceptions during the first four years, the greatest danger being in the first six months. A patient may be regarded as cured with fair degree of certainty if well after the elapse of four years after operation.

The intensity of the pigmentation of the tumor bears no relation to the prognosis.

Moulton confirms Hagen's report regarding the favorable prognosis when the patient is operated on before penetration of the ocular coats. Four such patients with sarcoma of the choroid operated on by him were well, two, five years after operation, one three years after, and one a few months after operation.

Verhoeff and Loring collected from the literature fifty-three cases of primary epibulbar sarcoma removed by local excision. Forty-four of these were traced and only eight were well six months to ten years after operation; thirty-six or 81.8% developed recurrence; nineteen cases were treated by primary enucleation and nine had deep extension or metastases at time of operation; of the total fifty-four traced cases metastatic recurrence developed in 12 or 22%.

They consider epibulbar sarcoma usually a very malignant tumor but capable of early diagnosis in a stage of still very circumscribed infiltration because of the superficial location and the resistant character of the cornea and sclera.

The result after local excision have not been good and after the diagnosis has, therefore, been established by section, enucleation is the operation of choice.

Goldchtein reports seventy cases collected from the literature in which enucleation was practiced with no metastases or recurrences in sixteen of twenty-three traced patients.

Strouse reports rather a different conclusion on sarcoma of the corneal limbus, though his facts do not well support this difference. Metastases never occur nor invasion of the eyeball. Exenteration or enucleation are, therefore, never justifiable. He reports twenty-four cases: Five recurred within several months to two years. Six alone believed to have been cured; the duration of the postoperative period is not given.

La Grange (vol. i., pp. 467–) who has made a most careful pathological study of the ocular sarcomas reports thirty-three patients traced after operation. Eighteen were free from recurrence for one year and fifteen died of recurrence. Of these fifteen cases thirteen were tumors of a more round cell type. He believes that prognosis after operation is fairly favorable in the spindle cell growth of the unpigmented type of tumor. He believes that a little less than 25% are cured by operation.

As is true with our own cases, the reports upon the radium treatment of sarcomas of the eye is practically limited to recurrent growths. The majority of these reports have also corresponded with our experience.

Finzi reports a complete retrogression of a twice recurrent sarcoma in the orbit after three treatments with 150*mgr* of radium bromide filtered through 2*mm* of platinum.

Flemming showed two cases of sarcoma of the eyeball successfully treated with radium and an apparent complete cure. First case was treated over two years ago.

Klock reports two epibulbar sarcomas of the eye, one covering the cornea and the other extending over the papillary area, apparently cured by radium and a third case of melanosarcoma of the ciliary body extending into the papillary area and displacing the iris forward, greatly reduced in size.

Heckel reports one case of epibulbar sarcoma successfully treated by X-rays.

Snell reports a melanosarcoma occupying the inner ⅔ of the cornea conjunctival limbus, which disappeared after twelve X-ray treatments. There was no recurrence two years and seven months later.

Van Duyse reports a case in which there was freedom from recurrence of seven months' standing after total exenteration for recurrent sarcoma of the orbit by the X-rays.

In sarcoma of the eyelids we have had no experience, but from our experience with sarcoma elsewhere it is a lesion which should yield well to radium, presumably by embedding emanation in the growth. Alling has collected sixty-five cases of sarcoma of the eyelid from the literature. Recurrence was the rule after operation for these growths. One case, however, was free from recurrence for thirteen years and another for five years.

Dr. Abbe, as early as 1910, reported a cure of five years' standing of a sarcoma involving ⅔ of the lower lid by the application of radium.

KERATITIS

The case of interstitial keratitis is in a girl twenty-four years of age, having started twelve years before she began treatment with us. The patient had received every form of treatment, including, of course, antisyphilitic treatment, without benefit. The seven radium treatments, between January 24th and October 1st of this year, which we administered, produced also no improvement. Because, however, of the favorable effect on chronic inflammatory processes in the cornea reported by others, particularly by MacKenzie and Cuperus, it may be that failure in our case was due, in part at least, to the age and chronic character of the lesion, though these favorable results in inflammatory conditions have not been duplicated by others.

In treating inflammation of the cornea we recommend that the radium emanations be filtered through ¼ to ½*mm* of silver, applied at a distance in front of the cornea of at least 1*cm* and a dosage of 60 to 100*mc* hrs. We have had no further experience in diseases of the cornea than the single case above referred to and no experience whatever in the treatment of disease of the iris.

Mattice reports the successful treatment of a corneal tumor with radium. He also refers to Koster's work, published by Leiden in 1905, in which radium gave very favorable results in a number of chronic inflammatory conditions of the cornea, iris, and choroid, and no effect at all in retinitis pigmentosa or optic nerve atrophy. He also failed, contrary to the experience of Levin and Cohen, in cataract of the lens. Levin, at the last meeting of the A. M. A., gave a most favorable report of the treatment of cataract by radium.

GLIOMA

Of the six patients with glioma of the retina, one patient whom Dr. Schoenberg referred to us and who was exhibited to this section last spring, has done remarkably well.

This patient, a child, now of four years, had the left eye removed in December or November, 1916, and was treated for glioma of the left retina by radium April 10, 1917, and since this time, as far as I have been able to discover, the condition has remained stationary and the child now sees well.

Of the other patients treated, the subsequent fate can be traced in only three. One of them, a child of twenty months, in which the left eye had been previously removed and who had an advanced glioma almost completely destroying the vision on the right eye, was treated six times between May 25, 1918, and March 7, 1919, with heavy dosage.

The treatment, so far as can be ascertained, produced no change in the course of the disease, and the child is now dying from assumably cerebral metastases. This, of course, does not mean that the radium has not produced a local destruction of the tumor. The other two patients are still under treatment. One of them had an advanced glioma in both eyes, so that the subsequent fate is also of comparatively little importance. The other and only remaining patient, 6½ years of age, was referred to us by Dr. Knapp. The left eye had been previously removed and the right eye contained a growth, in perhaps what may be termed the second or moderately advanced stage of glioma.

He has received to date three heavy treatments between June 23, 1919 and October 6, 1919, and Dr. Knapp reported to me when he last examined the child that he thought the process, though a little more advanced than at first, had lately shown some improvement. We have heard lately by letter from the child's mother that the vision is becoming much worse.

To-day, therefore, much the same conclusions must be drawn about glioma of the retina as about sarcoma of the choroid, but perhaps with a little greater leaning toward the treatment by radium as opposed to operation. The same isolation of early glioma retinæ by the coats of the eyeball exists as was emphasized in the consideration of early sarcoma of the choroid. Therefore, our experience, as in choroidal sarcoma, so also in glioma of one eye, demands operative removal. The average percentage of operative cures of glioma in six reports by Adam, Holmes, Carlo, Owen, Wintersteiner, and La Grange, is about 46%. This percentage is probably very high and 13% to 21% of a large number of cases collected from the literature by La Grange plus additional cases of his own is more accurate.

Adam, in reviewing all cases during twenty years treated at the eye clinic in Berlin, traced the fate of forty-four of forty-seven patients, of which 54.5% were cured by operation. He concludes that an enucleation undertaken in the first stage in which the glioma is still confined within the eyeball gives 93% cures. He reports no patient cured by operation for recurrences. Extraocular extension of the disease occurred in seventeen cases and only one of these remained well for three years. He has collected eight cases from the literature which, in spite of the fact that extension had occurred to the optic nerve, were saved by enucleation or evisceration of the eyeball.

Holmes reports four cases cured by operation, all at the end of the first stage.

Carlo reports sixty cures of glioma of two years' standing and nine of one year's standing, out of 252 cases operated on. Of the recurrences only three occurred after twelve months' time. He confirms Adam's report on the bad prognosis for recurrent cases. Of thirty-nine cases of bilateral glioma, seven were well after two years following double enucleation.

Owen reports twenty-four patients operated on for glioma of the retina. Of these eight were well eight and one half months to eight years later.

Wintersteiner reports cures of three years in 16% of cases of glioma operated on.

La Grange (vol. i., pp. 676–) has collected twenty cures of cases of glioma of the retina reported up to 1890. In addition to these he quotes the table of Wintersteiner, summarizing 497 cases of glioma retinæ, of which there were sixty-eight cures with a postoperative period varying between two and twenty years, a percentage of 13.6.

La Grange adds eight new cases of his own, four of ten years, one, eight years, and three, two years or more. Further he adds a table of provisional cures in twenty-six cases with a postoperative history of six to eighteen months.

While we recommend, therefore, enucleation in primary glioma of one eye, it may be justifiable to use radium alone, or at least leave the decision entirely in the hands of the parents, if a tumor is discovered in the other eye, after removal of the one eye, when glioma proves to be bilateral, as it is in about 23% of the cases.

The method of treatment is the same advised for choroidal sarcoma, a dosage of 3000*mm* hrs. at a distance of 3*cm* and filtration through 2*mm* lead applied over the temple and in front of the eye.

Others have favorably reported the use of radiation in glioma. Purtscher strongly recommends radiotherapy with Roentgen rays after the technic devised by Axenfeld in glioma.

Duncan reports three rather advanced cases of glioma of the retina cured by the application of radium after operation, in one case after the recurrence had taken place. Axenfeld is very enthusiastic over the treatment of glioma retinæ with

X-rays. He reports the disappearance of an early lesion in the eye of a patient whose other eye had been removed for glioma.

He recommends X-ray therapy in early gliomatous eyes and even after enucleation for early gliomas and recurrent lesions.

NÆVI OF THE LIDS

Excellent results have been obtained in the treatment of nævi of the lids. We have treated more than three cases, as many of these nævi are classified as lesions of the skin. In all of the three cases here reported, the red birthmark has been replaced by a cutaneous surface only slightly paler than the normal skin.

The majority of these lesions occur in children and the treatments are best made short. Moreover, the majority of these lesions are superficial and little filtration is needed. The very superficial lesions are treated with filtration of only .2*mm* aluminum at a distance of .5*cm*, giving a dosage of 12 to 15*mc* hrs. per sq. cm. We recommend for irregularly shaped, larger, superficial nævi the use of applications very carefully shaped to the contour of the lesion, upon which the radium must be uniformly distributed.

Deeper nævi may be treated with .5*mm* of silver filtration at the same distance from the skin and a dosage of 40 to 60*mc* hrs. per sq. cm according to the extent of the lesion.

In other parts of the body large cavernous nævi or angiomata forming discoid elevations have been successfully treated with emanation buried in the center of the tumor.

VERNAL CATARRH

The treatment of vernal catarrh by radium has been most successful. This disease has long been considered one of the most rebellious of the inflammatory conditions which comes to the ophthalmologist, the usual conjunctival application and methods of treatment seldom producing much, if any, effect. A single radium application is capable of producing an improvement approaching a cure. Sometimes a second treatment is necessary.

During the past two years we have treated twelve patients and all of them have been so improved that they may be regarded as closely approaching a cure.

Due to inexperience in a few of the earlier cases, some little scarring has been produced, but never to a degree which has seriously diminished the return of the conjunctiva to its normal function.

The method now adopted is the application to the tarsal surface of the conjunctiva of a very thin .1*mm* piece of lead cut to accurately fit the tarsus and evenly covered with the active deposit from emanation.

Such a method makes possible an absolutely uniform distribution of all the therapeutic radiations from radium, in complete equilibrium to the surface of the tarsal conjunctiva. It also permits of making the application from a flexible soft piece of lead which can not only be inserted between the orbital and the tarsal conjunctiva but can even be covered by folding another piece of lead of the same thickness over it in such a way as to filter the side against the orbital conjunctiva through .2*mm* of lead. The three layers of lead then form an applicator .3*mm* thick, which is still very flexible and still capable of insertion between the tarsal and the orbital conjunctiva. We have followed this method in the treatment of our series of vernal catarrh cases and the results have been good. The irritation due to the more heavily filtered radiations falling upon the orbital conjunctiva plus also a certain amount of secondary radiations have proved to be harmless, in fact, no evidence of this irritation has been manifest later.

If, however, the surgeon wishes to evert the lids and treat only the tarsal conjunctiva for the sake of assuring the orbital conjunctiva a still greater protection, the upper lids may be everted and so held during the whole time of the application by the pressure of the same activated lead fastened with paraffin to the end of a hand-held wooden holder cut to a corresponding shape. The reason for cutting the end of the holder to the same shape as the activated lead is to ensure accuracy of application. We have not used this method because of the inconvenience of holding such an applicator, and finally because no harm has resulted from the simpler procedure of slipping the applicator under the lid in its normal position. Of course the eye is cocainized during the treatment.

In any case the use of active deposit instead of radium tubes is a better method because of the far greater uniformity in the distribution of the radium activity by this method than when single tubes are used.

Our dosage has varied from 200 to 400*mc* min. by these activated applicators. With applicators of 50 to 100*mc*, the total duration of the exposure is only four minutes.

Excellent results have of course been obtained by other methods.

Butler reported two cases in which he applied 45*mgr* for five minutes, 7*mgr* for eight to fifteen minutes, respectively, in tubes to the everted lids. These treatments were repeated once in the first place and five times in the second.

Shumway reports an excellent result in a boy who for five years had resisted all other treatment. He gave five treatments of 35*mgr* for fifteen minutes.

Pusey has treated a number of cases during the past few years in some instances with X-rays and in other cases with radium.

He has applied 5*mgr* of the element over the lid just short of contact for about thirty minutes, each portion of the surface of the conjunctiva getting about ten minutes. The application lasts five minutes on six successive days. The treatment is repeated after several months. He considers X-rays as efficacious. All his cases were of long-preceding duration, severe, and unyielding to other methods tried. His results were very gratifying.

Dr. Shine showed a case of vernal catarrh treated with radium at the Academy, October 16, 1916. Four treatments of 20*mgr* of from twenty-five to thirty-five minutes' duration were given. He reported treatment of four other cases and all did well.

Dr. Crigler presented two good results on May 20, 1918.

Lawson and Davidson report two cures, in the first case treated with 39 to 44*mgr* in eight exposures extending over twelve months, and the second six exposures during four months, each exposure lasting ten to twenty minutes.

A review of these reports demonstrates the simplicity and greater accuracy of the use of active deposit after the method described.

EPITHELIOMA OF THE ORBITAL CONJUNCTIVA

In this disease and in epithelioma of the lids, quite as much as in vernal catarrh, if not more so, radium has performed, in the experience of the Memorial Hospital, a service which is not too much to term indispensable.

I have collected the results in two cases of epithelioma of the orbital conjunctiva and sixty cases of epithelioma of the lids.

Both patients with orbital epitheliomas were referred to the hospital by Dr. Weeks.

The first patient, a man of fifty-seven years, was treated on December 20, 1917. At that time he had a nodular elevation on the scleral conjunctiva near the outer lower portion of the periphery of the cornea of the left eye and a pterygium-like extension on the adjacent surface of the cornea. The trouble was first discovered eight months before. The diagnosis was made clinically.

On December 20, 1917, 42*mc* of emanation unfiltered was applied by a brass cone at a distance of 1*cm* over the lesion for twenty minutes. On September 30, 1918, the local ophthalmologist reported that the lesion had undergone continuous retrogression and at that time the patient was still free from any evidence of disease.

Inasmuch as no microscopical diagnosis of this case was made, it may have been benign in its character. The previous existence of the growth for only eight months is, however, against the view.

Two such benign cases have been reported cured by mesothorium, one by Koellner and another by Agricola.

The second patient was a girl twenty-five years of age. Twelve years before applying for treatment a small reddish colored spot had developed external to the outer quadrant of the cornea on the bulbar conjunctiva. One and a half years before applying for treatment, it began to increase in size and became elevated. Two months before treatment it had been excised and a microscopical section confirmed the clinical diagnosis of epithelioma. Four X-ray treatments were given after the operation but the growth recurred and on September 19, 1917, two grape-seed sized nodules separated by a cicatrix were present on the scleral conjunctiva external to the corneal margin.

Five treatments, probably an unnecessary number, were given between September 19, 1917, and December 15, 1917, as follows:

September 19, 1917, 30*mc* filtered by .5*mm* silver were applied at a distance of 1*mm* in an applicator made of dental modeling compound for one hour;

October 18, 1917, 100*mc* were applied in the same manner for fifteen minutes;

On the other dates, 20*mc*, 46*mc*, and 38*mc*, respectively, were applied at distances of 1 to 1½*cm* in cones for twenty minutes.

On September 30, 1918, and ever since to date, there has been no evidence of the disease.

Such treatments as these are therefore efficacious in destroying epithelioma of the orbital conjunctiva and do the retina or cornea or rest of the eye no harm.

Though both these patients received treatment by means of the brass cone applicators, we now recommend the first method used, a hole approximately .5*cm* to 1*cm* in diameter cut in a piece of 2*mm* lead, one or two radium tubes placed over its center and fastened to it by paraffin. The eye is then opened by means of one of the regular lid separators and a spot marked in such a position on the wall of the room that when the patient fixes the gaze upon it, in a convenient position of the head, the growth on the orbital conjunctiva occupies a high position in the middle of the speculum over which now the applicator may be placed. We recommend silver filtration and two applications at relatively near dates of 30*mc* hours each.

The cure of a case similar to our own, by radium, has been reported by Collins in 1915.

EPITHELIOMA OF THE LIDS.

Equally brilliant results have been obtained in the treatment of epithelioma of the lids.

A successful result has been obtained in practically all of these cases. This does not mean that a cure to date has been obtained in all, nor does it mean that in many advanced cases the eye was ultimately saved.

It does mean that early epitheliomas of the lids have been cured to date, often by single applications, and that the eye has been saved. In other more advanced cases it was necessary to sacrifice the eye in order to properly treat the lesion.

A few patients having advanced recurrent lesions or lesions having had a long course of previous treatments by various methods or agents, have not been benefited.

Radium, however, not only cures these lesions but does so with less deformity than operation. It will often save an eye that operation will not save. It has been used successfully in one of our cases after operation for removal of the growth had been demonstrated to have been incomplete by microscopical section.

Its use, therefore, becomes important after operation to prevent recurrence. Inasmuch, however, as its success after operation depends upon its power of destroying what the operation itself has left behind, it is unquestionably an error to operate on these cases rather than treat them primarily with radium as the method of choice in the treatment of epithelioma of the lids.

Quite aside from the danger that operation may not remove the whole growth, it increases the danger of recurrence by the trauma it inflicts and the risk of causing inflammation in the wound.

The efficiency of radium in the treatment of epithelioma of the lids frequently depends upon the basular cell character of these tumors and its success is best illustrated by referring briefly to a few illustrative cases.

These cases may be classified into three groups:

First. Those cases in which practically no destruction of the lids has been caused.

Second. Cases with definite or complete destruction of the lids. The lower lid is far more frequently involved.

Third. Those cases in which the disease has infiltrated the orbital conjunctiva to a degree necessitating removal of the eye.

Epitheliomas of the eyelid of the first and many of the second class are best treated by surface application. Such is made more accurately by making first a mold of the diseased area and surrounding tissue of dental modeling compound. The compound is warmed and thus softened. It is then placed over the area mentioned and left to cool and harden. When hard it is removed and the diseased area is outlined upon it. The radium enclosed in *½mm* silver tubes, one to every sq. cm., is inserted in the mold, which is replaced and left over the growth long enough to administer 60*mc* hrs. per sq. cm.

Our own results have been confirmed by numerous reports in the literature.

Boussi reports eight cases of epithelioma of eyelids treated by radium and gives the bibliography from 1904 to 1913.

Poulard reports the cure of an advanced inoperable case.

De Lapersonne also reports favorable results on a number of cases, so also *Scoini.*

Del Mazo reports another cure. He used 90*mg* of armide daily, giving each time fifteen to twenty-two hours filtered through lead. Total dosage was 228 hrs.

Cavara reports sixteen cases cured by local applications of radium. No recurrences to date, but all recent.

REFERENCES.

1. ABBE, R. "Radium in Surgery." *Arch. Roentg. Ray*, 1909–10, xiv., 277.
2. ADAM, C. "Statistical, Clinical, and Anatomical Observations on Glioma Retinæ." *Zeit. Augenheilk.*, 1911, xxv., 330.
3. AGRICOLA, B. "Fünfmal rezidiviertes Papillom des Binde-und Hornhaut, geheilt durch Mesothoriumbestrahlung." *Klin. Monatsbl Augenheilk.*, 1913, li., 650–654.
4. ALLING. "Primary Sarcoma of the Eyelid." *Ophthal. Rec.*, 1907, xvi., 282.
5. AXENFELD, KÜPFERLE, and WIEDERSHEIM. "Glioma Retinae und intraokulare Strahlentherapie." *Klin. Monstabl. Augenheilk.*, 1915, liv., 61.
6. BOUSSI, G.-P. "Les epitheliomas de la paupière; contribution à leur étude thérapeutique. Radium thérapie. Radiothérapie." Thèse (Paris), 1914.
7. BUTLER, T. H. "Spring Catarrh: With Special Reference to its Diagnosis and its Treatment with Radium." *Brit. J. Ophth.*, 1917, i., 411.
8. CARLO, E. "Le prognostic des gliomes de la rétine." Thèse (Paris), 1909.
9. CAVARA, V. "Contribution à l'emploi du radium dans l'épithélioma des paupières." *Ann. d'oculist.*, 1911, cxlvi., 256.
10. COLLINS, T. *Arch. Ophthal.*, 1915, xliv., 577.
11. CRIGLER, L. W. *Report Proc. Sect. Ophthal., N. Y. Acad. Med.*, May 20, 1918.

12. CUPERUS, N. J. "Mesothorium Treatment of Eye Diseases." Trans. from *Arch. Augenhlk.*, 1914, lxxvii., in *Arch. Ophthal.*, 1917, xlvi., 126–129.
13. DE LAPERSONNE, F., and DEGRAIS. "Le traitement des tumeurs des paupières par le radium." *Arch. ophtalmol.*, 1919, xxxvi., 539–545.
14. DEL MAZO, J. G. "Epithelioma of Lid Cured by Radium." *Arch. Oftalmol.*, Sept., 1911; *Ann. Ophth.*, 1912, xxi., 182.
15. DUNCAN, R. "Glioma of Retina, with Report of Three Cases Treated with Radium." *Ann. J. Ophth.*, 1918, i., 715.
16. FINZI. "Recurrences in the Orbit after Removal of Endothelioma of the Lacrimal Gland. Treated by Radium." *Trans. Ophth. Soc. U. K.*, 1916, xxxvi., 244.
17. FLEMMING. "Radium und Mesothorium der Ophthalmologie." *Strahlentherap.*, 1914, iv., 861.
18. FREUNDENTHAL, G. "Ueber das Sarkom des Uvealtractus." *Arch. f. Ophth.*, 1891, xxxvii., 137–184.
19. FUCHS, E. "Das Sarkom des Uvealtraktus." Wien, 1882.
20. GOLDCHTEIN, E. "Le sarcome primitif de l'iris." Thèse (Paris), 1909.
21. GRIFFITH, A. H. "The Prognosis of Choroidal Sarcoma." *Ophth. Rev.*, 1891, x., 353.
22. HAGEN, S. "Melanosarcoma in the Eye." *Norsk. Mag. Lægevidensk.*, 1916, lxxvii., 317; *Arch. Ophth.*, 1916, xlv., 608.
23. HECKEL, E. B. "Epibulbar Sarcoma." *Ann. Ophthal.*, 1916, xxv., 474.
24. HOLMES, C. R. "Glioma Retinæ." *J. A. M. A.*, 1903, xl., 820.
25. KLOCK, TH. "Der Wirkung radioaktiver Strahlen auf Augenkrankheiten." Inaug.-Diss., Berlin, 1914; *Klin. Montsbl. Augenheilk.*, 1915, liv., 361.
26. KNAPP, HERMAN. Discussion on "Pseudoglioma from Traumatism" by H. D. Noyes. *Trans. Amer. Ophth. Soc.*, 1887, 488.
27. KOELLNER. "Epithelial New Formation at the Corneal Limbus which Recurred for Five Years and was finally Cured with Mesothorium." Trans. from *Arch. Augenhlk.*, 1914, lxxvii., in *Arch. Ophthal.*, xlvi., 130–134.
28. LA GRANGE, F. "Traité des tumeurs de l'œil, de l'orbite et des annexes." Paris, 1902–1904.
29. LAWFORD, J. B., and COLLINS, E. T. "Sarcoma of the Uveal Tract with Notes of One Hundred and Three Cases." *Roy. London Ophth. Hosp. Rep.*, 1890–93, xiii., 104.
30. LAWSON, A., and DAVIDSON, J. M. "Radiumtherapy in Eye Disease." *Brit. Med. J.*, 1910, 1491.
31. LEVIN, I., and COHEN, M. "The Action of Radium on Cataract." *New York Med. J.*, 1918, cviii., 4.
32. MARSHALL, C. D. "Sarcoma of the Uveal Tract." *Roy. London Ophth. Hosp. Rep.*, 1903, xv., 51.
33. MARTIN, W. "Beitrage zur Prognostik der Uvealsarkome." Inaug.-Diss., Halle, 1885.

34. Mattice, A. "Report of the Successful Treatment of a Corneal Tumor with Radium, with Remarks on Radium in Ophthalmology." *Arch. Ophthal.*, 1914, xliii., 237.
35. Moulton, H. "Leucosarcoma of Choroid." *Southern M. J.*, 1916, ix., 738.
36. Owen, S. A. "Glioma Retinæ." *Roy. London Ophth. Hosp. Rep.*, 1905–1906, xvi., 323.
37. Poulard, A. "Epithéliome de la paupière traité par le radium." *Arch. Ophtal.*, 1910, xxx., 146.
38. Purtscher, O. "Glioma of Retina." *Cent. Prak. Augenhlk.*, 1915, 193.
39. Pusey, W. A. "Treatment of Vernal Conjunctivitis with Radium." *J. A. M. A.*, 1918, lxxi., 806.
40. Scaini, N. "Roentgen Treatment in Ophthalmology." *Rif. Med.* (Naples), 1919, xxxv., No. 5.
41. Shine, F. W. Ophthal. Sect., N. Y. Acad. Med., Oct. 16, 1916.
42. Shumway, E. A. "Vernal Conjunctivitis Greatly Improved by Radium Treatment." *Am. J. Ophth.*, 1918, i., 404.
43. Snell, A. C. "An Epibulbar Melanosarcoma of the Limbus." *Trans. Amer. Ophth. Soc.*, 1916, xiv., 556.
44. Stirling, A. W. "On Primary Sarcoma of the Orbit, with Notes on Twenty-nine Cases." *Roy. London Ophth. Hosp. Rep.*, 1890–93, xiii., 529.
45. Strouse, A. N. "Sarcoma of the Corneal Limbus." *Arch. Ophth.*, 1897, xxvi., 217.
46. Van Duyse. "Myxochondrome sarcomatode de l'orbite." *Arch. Ophtal.*, 1913, xxxiii., 529. (*Soc. Belge d'opht.*, xxxvi., 529.)
47. Verhoeff, F. H., and Loring, R. G. "Primary Epibulbar Sarcoma." *Arch. Ophth.*, 1903, xxxii., 97.
48. Wintersteiner, H. "Das Neuroepithelioma Retinae." Leipsic and Vienna, 1897.
49. Wood, C. A., and Pusey, B. "Primary Sarcoma of the Iris." *Arch. Ophth.*, 1902, xxxi., 323.

A CASE OF TRIGEMINAL NEURALGIA.[1]

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NEURALGIA associated with the distribution of the fifth nerve, or tic douloureux as it is sometimes called, has long been found a fertile subject for discussion, conjecture, and experiment. It has been attributed to causes without number ranging from the rather indefinite "neuropathic tendency" to the much overworked dental complications of the present day. Yet it has been impossible in a large majority of cases to assign to it any definite pathology, and, unless other cranial nerves are involved, it has been difficult to differentiate between possible causes of a peripheral and those of a central origin.

A very significant statement is made by Dr. Edward W. Taylor in Osler's *System of Medicine*: "In the periphery a true primary neuritis of this nerve is exceedingly rare, and a neuritis secondary to disease in the neighborhood is also infrequent. Involvement of the nerve is naturally frequent in traumatism of various sorts, but it is rarely damaged in ordinary skull fracture. The pathological anatomy underlying the frequent neuralgia of the nerve is as yet wholly indefinite. Its association with arteriosclerosis, particularly in the neighborhood of the Gasserian ganglia, no doubt has some significance, but certainly in many cases is an insufficient and incomplete explanation of the pain. The studies of Spiller, Barker, Rusk, and Cushing have shown certain alterations in removed Gasserian ganglia, but not sufficiently characteristic to permit of their definite association with neuralgia."

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Similar opinions as to the uncertain pathology of this malady have been expressed by other careful observers, and yet, even with this uncertainty, there has been a gradually increasing tendency towards methods for its relief which involve either decided impairment of function or absolute destruction of important nervous tissue. Of the various forms of injection employed only those which destroy portions of the nerve are considered successful. As to surgical methods, they are all aimed directly at an actual and permanent break in either the smaller or larger nerve channels; while the more radical of the operations commonly advocated, the removal of the Gasserian ganglion, brings as its sequence an absolute obliteration of one of the most important sensory areas of the body. In addition these various surgical experiments are almost invariably accompanied with irreparable, and often distressing, deformity of the face.

It would seem, therefore, that, if a reasonable explanation of the frequently encountered neuralgias of this nerve could be reached and a cause determined upon, the removal of which would in no way involve the unfortunate sequelæ of the methods mentioned, all of these destructive surgical experiments might well be abandoned.

In 1877 attention was called to the relationship between ocular defects and neuralgias of various types by Dr. George T. Stevens, who reported a number of cases, including several of trigeminal neuralgia, which were relieved by the proper correction of errors of refraction. Little was known at that time of ocular disturbances due to anomalous muscular adjustments, and no definite conclusion was reached as to the true relationship between the neuralgic pain and the eye defect.

Since that time, however, the researches of Dr. Stevens into the association of functional nervous diseases, and anomalous conditions of the ocular motor apparatus with their accompanying facial adjustments, have shed an abundance of light on many of these formerly obscure conditions.

A careful study of facial expression in its relation to ocular adjustments enables us to reach a logical and convincing explanation for many of the forms of idiopathic neuralgias, if they may be so called. This relationship is readily demonstrated in the neuralgias affecting the trigeminal nerve, and especially so in those cases where the pain is associated with the first or ophthalmic branch of the nerve, which is the form most commonly encountered.

The report of a typical case, chosen from among many, will serve as the best means of showing this association.

The patient was a clergyman, twenty-nine years of age, who was in charge of an important parish in northern New York. He was brought to me on September 11, 1917, by Dr. Charles R. Payne of Wadhams, N. Y.

He stated that he had always suffered from migraine. In 1910 he first began to have periodic attacks of severe supraorbital pain. At first the attacks appeared at intervals of about six months, but gradually increased in severity and frequency and in 1917, at the time he first consulted me, they were recurring about every two months.

The pain started in the supraorbital region of the left side and would extend backwards to the parietal eminence of the same side and thence to the occipital region. It was generally accompanied with severe orbital pain. In character the pain was typical of the condition known as clavus hystericus—that is, a sensation similar to that of a hammer being driven into the skull at frequent intervals. The attacks of severe pain would last for a period of ten to twelve hours and would then be followed by lesser pain which would continue for a longer period. The points of Valleix, or tender spots, were present in the eyeball, over the supraorbital notch, and over the parietal eminence of the left side.

The pain was so severe that at times there was complete loss of consciousness, and for three years this loss of consciousness had frequently been followed by convulsive seizures of an epileptiform character. There was also present on numerous occasions a fugitive paralysis of the right arm.

The lapses of consciousness would last from a few minutes to several hours and on a number of occasions for two or three days. Severe mental disturbance often accompanied the attacks. The patient states that during one attack he ordered his wife out of the house and on another occasion he threatened his physician with a revolver.

Memory of the attack was sometimes completely lost. He describes one attack which was ushered in with headache and nausea coming on during his sermon at a Sunday morning service. He remembers conversing with some of his congregation on the steps of the church after service, but from that time has no recollection of anything that transpired until the following Tuesday morning.

He also stated that for years he had not had a normal appetite.

The patient had been under Dr. Payne's observation for a considerable period and he had been unable to find evidences of any lesion of an organic nature. The only way in which he had been able to alleviate the attacks was by the use of morphine which he had employed in doses as large as ¾ of a grain, giving as much as two grains in twenty-four hours. Even with such doses it had required from twenty-four to thirty-six hours to control an attack. On one occasion morphine had been of no avail and he had employed hyoscine in full doses.

Other medical friends had strongly urged the removal of the Gasserian ganglion and this would have been done had it not been for Dr. Payne's insistence that the ocular conditions should be carefully investigated.

Examination of the eye conditions made on the day of the patient's arrival, and repeated on the next day, revealed the following facts:

Examination with the ophthalmoscope showed no lesion of the fundus of either eye. He had a refractive error which was corrected to Vision $\frac{6}{6}$ with Sph. + 0.75 D. combined with Cyl. + 0.75 D., axis 90°, in each eye and was wearing this correction. With the phorometer he showed an esophoria of 2° and no hyperphoria. The rotations were practically normal in all directions. With the clinoscope, however, a declination was found amounting to + 2° in the right eye and + 5° in the left eye.

While the instrumental findings in such cases are, of course, highly significant, it is of the utmost importance that careful observations should be made of the facial expression and of the bodily pose. The necessity for the maintenance of the eyes in an erect vertical position in the interest of clear vision is so insistent that, in cases of heterophoria and declination, the eye muscles alone are frequently, in fact almost invariably, found to be inadequate, and assistance is demanded from the more vigorous facial muscles. As a consequence there are certain well defined and characteristic facial adjustments which always accompany the different forms of heterophoria and declination.

In this particular case the habitual facial expression and carriage of the head were in a marked degree characteristic of the anomalous muscular conditions shown by the instrumental tests.

Both of the brows were strongly compressed, the left to a greater extent than the right. There was a deep depressed vertical ridge in the space between the two eyebrows. Well defined transverse wrinkles were prominent on the forehead, and the integument appeared as if drawn forward and downward to the brows. The strong compression of the brows gave the eyes the appearance of being half closed. There was a constant spasmodic contraction of the whole face, more pronounced on the left side; in fact, the patient stated that at times this spasm was so intense that the eyelids became inverted.

This strong compression of the eyebrows is characteristic of esophoria, and its asymmetry is equally characteristic of a higher degree of declination on one side than on the other.

Assuming a close relationship between the neuralgic pains and the manifest ocular maladjustments, it was decided to remedy the latter as far as possible and in the period from September 13th to October 18th three operations were performed with the object in view of correcting the declination in both eyes. These operations were what are called extendo-contractions, in which the tendons of the recti muscles are severed from their attachments and then reattached to the eyeball in a position which will bring about an actual tilting of the vertical meridian of the eye, without in any way affecting the rotating ability of the muscles or inducing any heterophoric conditions. Such operations are attended with but slight temporary inconvenience to the patient. If properly performed, no perceptible trace of the operation will exist after a short period.

The patient then left for home and returned again in December with the report that there had been a decided improvement in all his symptoms. He had had no further severe attacks of neuralgia but there had been some slight headache. His appetite had become normal and he was eating three good meals a day. He was able to use his eyes and to read with no undue sense of strain or tension. There was also evident a decided change in his facial expression. Although there was still some compression of the left eyebrow, the appearance of spasm had practically disappeared and the lines of the forehead were scarcely noticeable.

Further examination revealed the fact that there was still about 2° of declination in the left eye and none in the right. A final operation was performed and when the patient left New York there was manifest only ½° of declination and ½° of esophoria.

Frequent reports of the case have reached me since that time and in October of the present year the patient called on me to report his condition.

In appearance his face was that of a person well at ease and there was no trace of the former strained and contracted expression. The forehead was smoothed out and there were no prominent lines. He stated that there had been no return of the neuralgic attacks during the two years since the operations on his eyes. The headaches had also disappeared and he was able to use his eyes with perfect freedom.

He also stated that there had been a great change in his mental condition. Previous to the work on his eyes he had been unable to do effective writing, was unable to get any substance into his sermons, and could not concentrate his mind on a subject for any length of time. At present he is preaching good sermons, is writing for several theological magazines, has added another church to his parish and is successfully conducting the work in both of them. In addition he is doing much public work of a taxing nature without ill results.

In arriving at an explanation of the association between the neuralgic pain and the faulty ocular adjustments, I think we may well depart from the traditional form of attributing it to reflex action. In this case it is easy to trace a direct mechanical cause for the nervous irritation expressed by the neuralgia.

The frontal branch of the ophthalmic division of the fifth nerve leaves the orbit in two branches, the supratrochlear and supraorbital branches, which pass out of the orbit over its prominent superior border and, passing upward underneath the muscles and in close proximity to the bones of the cranium, are distributed to the muscles of the forehead, the corrugator supercilii, occipito-frontalis, and orbicularis palpebrarum. Branches are also distributed to the integument as far back as the occiput, and to the pericranium of the frontal and parietal bones.

The close proximity of these sensory nerve filaments to the unyielding bony structure over which they pass makes them exceedingly liable to irritation from any undue pressure; and when this pressure and tension are exerted over an extended period, it is natural to assume that the continued irritation will express itself as pain.

With these simple factors in mind we are in a position to formulate a reasonable explanation for the sequence of conditions leading up to the neuralgia.

The dominating factor in the whole sequence is the necessity for the maintenance of clear binocular vision, and the main obstacle to be overcome is the correction of the high degree of declination. In the efforts of adjustment for this condition the muscles of the forehead are drawn forward and compressed over the brows, thus being kept in a constant condition of overtension, and bringing to bear a direct mechanical pressure on the nervous elements of the region. The pressure results in irritation of the nerves and the irritation is manifested as pain. It is also reasonable to suppose that this pressure will be greatest over prominent points; hence we have areas of greater irritation or tenderness over the orbital border and near the parietal eminence, thus explaining the points of Valleix, while the muscular pressure on the eyeball itself to maintain it in the vertical position would explain the pain in that organ.

The logical conclusion, therefore, is that, if the unnatural tension of the muscles and integument of the forehead can be relieved, the pressure on the nerves will cease and the pain will disappear. This certainly cannot be accomplished by any measures undertaken for the destruction or removal of the nerve channels as such measures fail utterly in modifying in the least degree the true cause of the disturbance. Further, more frequently than not, they are inefficient and their exceedingly undesirable accompaniments of loss of function and disfigurement do not recommend them. The only rational method of relieving this tension is by the correction of the declination, which is the real cause of the facial distortion. Surgical procedure properly carried out for such correction is attended with no undesirable consequences, and results as thoroughly satisfactory as were obtained in this case may be expected to follow.

A NEW APPARATUS FOR TESTING ACCOMMODATION.

By Captain HARVEY J. HOWARD, M.C., Medical Research Laboratory, Hazelhurst Field, Mineola, Long Island, N. Y.

(*With eight figures in the text.*)

OF all the eye tests performed by a number of examiners, the one producing results subject to the greatest variation is the test for the near point of accommodation. These discrepancies may be caused by any one or more of several different factors:

(1) Difference in the size of the test objects.

(2) Difference in the speed of approach of the test object.

(3) Difference in the illumination and legibility of the test letters.

(4) Difference in the place of contact and the angle of the measuring rule.

(5) Difference in the position from which the reading is computed.

(6) Difference in the instructions to the subject.

(7) Difference in the personal equation of the examiners.

(8) Difference in the personal equation of the subject, *e.g.*, the motive of the examination.

In the examination of applicants for the United States Aviation service a test for the near point of accommodation has been made in every case. A comparison of the data, however, must convince one of the utter unreliability of the figures recorded. In the first place, the test was made subjectively, *i.e.*, the applicant was required to indicate, while the test card was approaching his eye, the first blurring of a letter. When we recall that the applicants were all endeavoring to make as good a showing as possible, it is easy to understand why many of the findings are absurdly small. Of all the factors referred to above as the cause of the great variation in the results obtained by medical examiners, the personal equation of the applicant is probably the most important. At the same time it is quite likely that all the other factors operated as well.

If the Air Medical Service is offered no alternative but to disregard the data on accommodation already recorded, it is also placed in the undeniable position either of discontinuing further tests or of devising a test which will give more consistent results. The importance of a good power of accommodation on the part of a flyer is so generally accepted that it seems unworthy to drop the matter summarily. The other alternative then must be accepted.

Our problem therefore is to devise a test which will both compel the adoption of a uniform method and produce objective results. The apparatus used at present consists of a Prince rule and a card of small letters or the Duane disk. Tests with this apparently should give very consistent and comparable results if carried out by one careful examiner under the same conditions. The apparatus is simple and inexpensive. Perhaps its chief fault is that, in being so simple it lends itself readily to very different and careless methods of use. From an ideal viewpoint an apparatus should be so constructed that it will automatically require a standard position in respect to the subject before a test can be accomplished. In the first place, it should not be required to be held in position by the examiner; it should either be set in a head-rest or held firmly in a fixed position by the subject. By such an arrangement several of the disturbing factors already mentioned would be eliminated. But as long as the test is applied subjectively, just so long will results still be inaccurate and incomparable when dealing with candidates required to pass a high standard. When dealing with office patients, the problem is an entirely different one. From them the examiner expects the fullest coöperation and generally receives it. Under such circumstances the approximation method, referred to below, should give consistent results if the other disturbing factors are eliminated.

If it is necessary to make the test objective, then letters or figures must be used. Furthermore, the test card must first be held so close to the eye that the letters are unrecognizable, and then carried slowly away until they first become legible. This is called the recession or objective method. Unless the subject has learned the letters prior to the test, it must obviously be considered an objective result the moment he reads them correctly. The usual method of examination is to bring the test card slowly towards the eye and require the subject to state when the test object shows its first blurring. This is called the approach or approximation method, and gives subjective results. This brings up the question as to the comparison between results obtained by approximation and recession methods.

The approximation method calls for the location on the diopter measuring rule of the first blurring of a letter or object. If the card is gradually brought further in, the letters finally become illegible. The result accepted quite generally by this subjective method is not the point of the first illegibility but the point of the first blurring noticed.

The recession method requires the card to be held close to the eye at the beginning and carried slowly away until the letters become legible. The position on the rule where this first legibility occurs is not the same as the point of illegibility by the approximation method. But as a matter of fact, attested by a number of experiments, the point on the rule indicating the first legibility by the recession method is the same or practically the same point as that indicating the first blurring by the approximation method. The difference in the two was found to be astonishingly small—in some individuals less than 1*mm* of actual measurement. With these results before us, our problem is made easier.

The only other requirement is that the letters will be so arranged or manipulated that their order cannot previously be learned. To meet all the requirements indicated above, an apparatus to be described below was designed.

The apparatus consists of four essential parts:

1. A hood with an observation aperture for one eye.
2. A rule attached to the hood, measured off in millimeters and diopters.
3. A test object carrier.

4. A set of test letters and test objects.

The following is a description of the essential parts in detail:

1. The hood (Figs. 1 and 2) is a combination of two three-quarter face masks. The cut out in the left half is for the nose when the right eye is looking at the test objects through the circular opening; the cut out in the right half is for the nose when the left eye is looking through the circular opening in the center of the hood. The hood is made of aluminum and of sufficient size for the largest face. In front of the aperture is a slot for holding lenses. Figure 1 represents the shape of the hood as one looks at it from above. Figure 2 represents the shape and appearance of the hood looked at from behind, *i.e.*, as the subject views it prior to adjusting it to his face. From these figures it is noticed that there is a bulging of the mask in the middle section below the circular opening. Into this section is set the measuring rule. This bulge is so formed that when the mask is adjusted to the face, and the rule is held in a horizontal position in respect to the vertical position of the head, it fits snugly against the malar bone which forms the lower anterior part of the orbit.

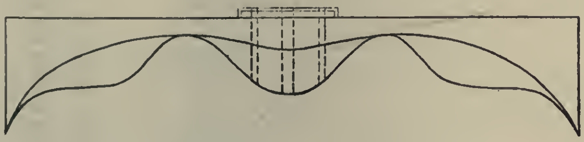


FIG. 1. View of the hood in cross section from above.

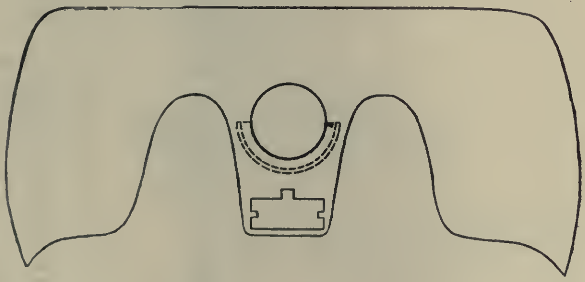


FIG. 2. View of the hood from behind as the subject sees it.

FIG 4

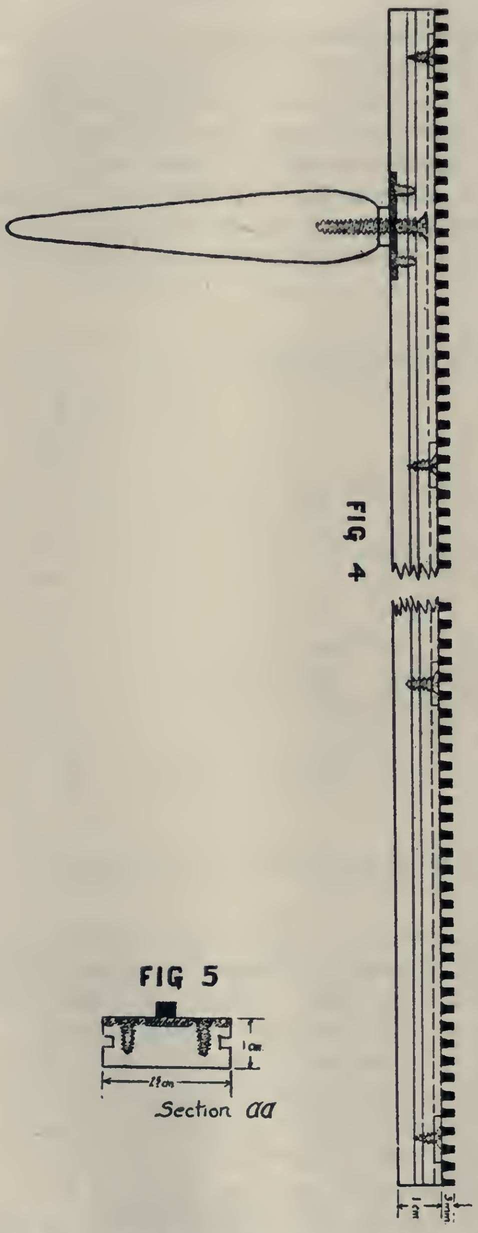


FIG 3

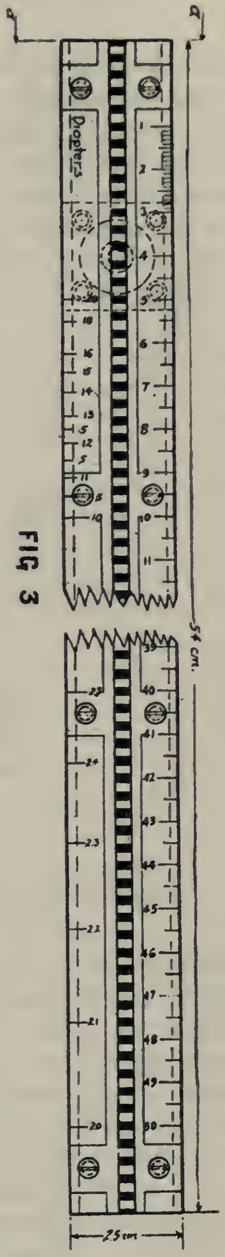
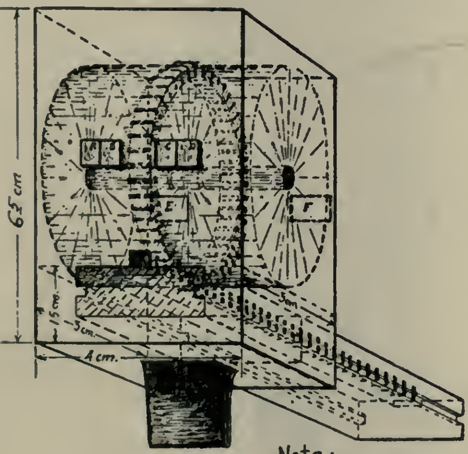


FIG 5

Fig. 3. The rule divided into millimeters and diopters.
Fig. 4. The rule showing handle and rack.
Fig. 5. Cross section of the rule.

2. The measuring rule (Figs. 3, 4, and 5), is made of wood and is 2.5*cm* wide and a little more than 50*cm* long. One end is set into the hood (Fig. 2) so that its median line is exactly beneath the center of the aperture. The left side of the rule (Fig. 3) is marked off in centimeters and millimeters. Zero on this scale is 17.5*mm* from the end of the rule where it butts against the malar bone. From a series of measurements on a number of individuals, it was found that the average distance from the malar bone, at a point directly below the pupil of the eye to a perpendicular line drawn tangent to the cornea was 6*mm*. Inasmuch as all measurements of accommodation should be made from the anterior focus which is 11.5*mm* in front of the cornea, zero on the scale must be located 17.5*mm* in front of the facial end of the rule.



Note :-
A, B, C, & D Front Windows 4 × 5 mm.
E & F Rear Windows 6 × 5 mm.
Outside Diometer of Cog Wheel 45 mm.
Outside Diameter of Drum 43.6 mm.

FIG. 6. Test object carrier showing drum which carries the test letters.

The right side of the rule (Fig. 3) is marked off in diopters and fifths of diopters so that the decimal system may be used. Extending the length of the rule (except for the first 4 or 5*cm* of the facial end), on its upper surface and located in a median line is a rack composed of metal cogs about 3*mm* high. Attached to the lower side of the rule, 4 or 5*cm* from the facial end, is a handle. In place of the handle there may be substituted a steel rod which can be fastened to a table clamp in case it is found desirable to make the apparatus stationary, as a head rest.

3. The test object carrier (Fig. 6) consists of a box of light metal containing a metal barrel which rotates about a central axis. The barrel is divided into two equal parts, left and right, by a circular rack of cogs, which coincide with those of the rule. Attached to the box beneath is a flat holder to be grasped by the thumb and forefinger. By this means the box may be propelled back and forth along the rule and the barrel made to rotate. The box may be propelled either by the subject or by the examiner. In the front partition of the box at its horizontal center are two small double windows lettered A, B, C, and D, in Fig. 6. By the addition of a metal slide only one of these windows may be open at one time. In the back partition of the box are also two windows. As the barrel rotates, letters or other test objects appear in succession before these windows. The windows in front permit test objects to be viewed by the subject when he looks through the aperture in the hood. The windows behind are made for the examiner who sees letters or test objects in the same series as the subject sees them. Figure 7 represents an ordinary test object carrier which may be used when the Figure 6 carrier is not required. A Duane accom-

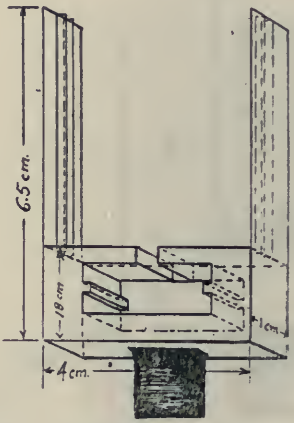


FIG. 7. Accessory test object carrier.

modation disk or any card of small test letters may be carried in this holder and the usual subjective test applied. The slot for carrying the test card should be flush with the front edge of the carrier so that the reading on the diopter scale may be facilitated.

4. The test letters and test objects are represented diagrammatically in Figure 8. The test objects are engraved on heavy white cardboard in two sizes. B and C which appear before windows B and C, Fig. 6, are 0.8*mm* high and A and D which appear before windows A and D are 1.2*mm* high. The actual length of the card is 140*mm*. In each row there are forty letters or objects which recur every 3.5*mm*. Rows E and F which are only diagrammatically shown in the figure are made as large as possible. They appear to the examiner at the windows E and F of the box. The opportunity is given to use either letters or the conventional E. The primary object of the letters thus arranged is to employ them as an objective test. The test carrier therefore must be started as close to the eye as possible and pushed slowly away until the subject is first able to read a letter or distinguish correctly the position of an E. The examiner who stands so that he can see the objects appearing at one of the windows in the back of the box is able

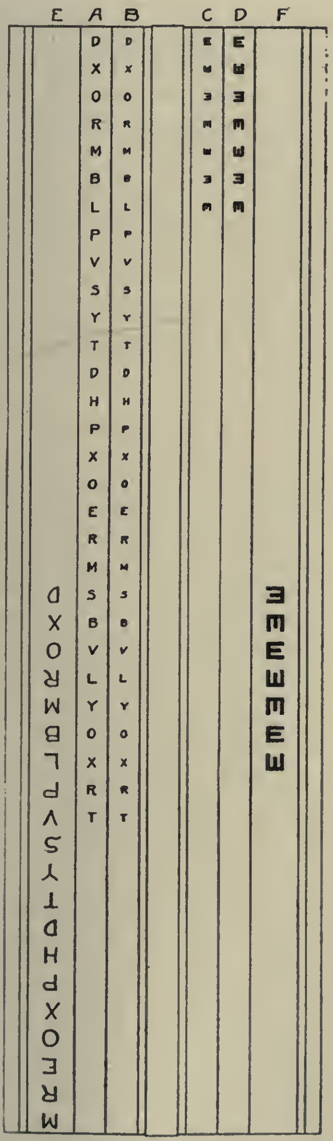


FIG. 8. Diagrammatic representation of the test letters and test objects.

to verify the statements of the subject because the letters or objects which each of them sees, occur in the same series. To the subject the test objects go up behind the window while to the examiner the test objects come down. If more than one reading is desired, the test carrier may be pulled off the rule and set back again in a different position, so that at the same distances from the subject's eye, different letters will appear from those previously seen.

THE PUPILLARY SYMPTOMS IN A CASE OF EMBOLUS OF THE CENTRAL ARTERY OF THE RETINA—WITH ESPECIAL REFERENCE TO THE PRIMARY REFLEX.

By JOHN DUNN, M.D., Richmond, Va.

Early in June, 1919, Mr. A., aged 36, became suddenly blind in his left eye. When seen a few days later the fundus presented the following picture. The retinal arteries were threadlike; the veins were much reduced in size; the nerve head was white; the well-known cherry spot occupied the region of the macula; everywhere, save for the exception noted below, the retina had lost its clear pinkish color, this being replaced by a cloudy white, indicative of the œdema present. This whitish hue was most marked above and below the disk and about the macula. Extending from the outer margin of the disk nearly to the cherry spot was *a tonguelike projection of normally pink retina.* Vision was abolished, except for an area which corresponded to this pinkish projection, the patient explaining that he could "see to the outer side of anything" he "tried to look at." *There was no direct response of the pupil to light;* the pupil, however, responded normally both in accommodation and consensually. The left pupil dilated more when the right eye was excluded from the light than the right pupil did when the left eye was excluded. The excess dilatation of the left pupil was, however, only moderate in degree. The normal pink of the tonguelike projection from the disk was probably due to the fact that this area obtained its nourishment from a cilio-retinal vessel. This vessel, however, was not visible to the ophthalmoscope. One month later the picture had changed. The disk now showed the white of extensive atrophy. The arteries were now threadlike. The veins were very much contracted. The cherry spot had disappeared, as had also the œdema and the pinkish contrast of the tonguelike projection. The fundus had returned, as far as my eye could see, to its normal color.

> Vision was no better than when the eye had been examined a month before. *The direct response of the pupil to light had returned.* The embolus of the central artery of the retina came from a cardiac lesion.

The case has two points of interest: I. The retention of the normal pinkish color of the retina in the tonguelike projection above described. The explanation for this has been given. Its interest is slight and is due to its rarity. II. *The absence of direct response of the pupil to light while the œdema was present and its return after the œdema had disappeared.* If the direct, *i.e.*, the primary, response of the pupil to light is the result of impressions which pass along the retina to the midbrain, then it should have been absent or present under both conditions. On the occasion of Mr. A.'s first visit the portion of the retina supplied by the cilio-retinal artery was functioning, as was shown by the patient's ability to see light and the details of objects and yet the direct response to light was absent. A month later there existed the same amount of vision, and no more, and yet the direct response to light was present. I can see but one explanation for this. On the occasion of Mr. A.'s first visit the œdema of the retina prevented the action of light on the retinal pigment cells. At the time of his second visit this œdema had disappeared and the pigment layer which does not derive its nourishment from the retinal vessels could be acted upon by the light—hence the presence of the primary pupillary response to light.

In more than one contribution to the ARCHIVES OF OPHTHALMOLOGY I have tried to prove that the direct response of the pupil to light is a primary reflex and is accomplished without recourse to the optic nerve and intracranial pupillary pathways so long as these are intact; that the primary pupillary response to light is an extracerebral reflex and that its nervous pathways are as follows: retinal cells to retinal pigment cells, along this pigment layer to the ciliary region where sensory impulses are aroused in the sensory nerves to the ciliary ganglion from this region, thence along these ciliary sensory nerves to the ciliary ganglion in the substance of which impulses are aroused in the motor cells of the ganglion which impulses passing outwards result in contraction of the pupil. In no other way can I see a possible explanation of the phenomena of the Argyll-Robertson pupil, of the behavior of the pupil in the second stage of ether anæsthesia, of the pupillary phenomena which just precede death, etc. This conception of the primary response of the pupil to light is of the first importance. Without it, as I see it, the pupillary phenomena in health and in disease will continue, as they always have been, unintelligible. In the case here reported, it is probable that all of the retinal cells except those in the area nourished by the cilio-retinal vessel have atrophied and the light stimulus to the pigment layer is received only from impressions made upon this cilio-retinal region. Inasmuch as the primary response of the pupil to light is within limits proportionate to the amount of light stimulus to the pigment layer, we have in the case of Mr. A. a weaker contraction of the left pupil than of the right to the same degree of illumination.

THE MADDOX MULTIPLE RED ROD: A CONSIDERATION OF SOME OF ITS OPTICAL DEFECTS.

By Captain PERCIVAL DOLMAN, M.C., Medical Research Laboratory, Hazelhurst Field, Mineola, Long Island, New York.

DURING the course of a series of experiments made for the purpose of investigating the accuracy of the Maddox rod test, it was discovered that the line of light often appears nearer than the light which is located six meters away. The statements of a number of observers have repeatedly verified this fact.

When the line is in sharp focus, it is seen as a bright band of light, of uniform density, with sharp, clean-cut edges. Such a line appears to be located at the same distance as the light. When the line is not in focus, it is seen as a wider band, of unequal brightness, with hazy, irregular edges. The general effect is that of indistinctness. The line then appears to be located often only a few feet from the eye.

The influence on the Maddox rod test of this false localization of the line is in favor of the measurement of an excessive amount of esophoria.[1] The appearance of the line of light, therefore, has a direct bearing on the accuracy of the test.

The same indistinct appearance of the line may be caused by certain optical defects in the Maddox rod. An examination of the several rods which were being used at the time, disclosed such a high percentage of defects that a special investigation was begun to determine the optical qualities of other Maddox rods in general use. The results of that investigation form a part of this report.

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[1] Dolman, Perc., "The Maddox Rod Screen Test." Archives of Ophthalmology, September, 1919.

Twenty multiple red rods were examined. Some of them were in use in the laboratory, others were found in nearby clinics, and a few were obtained from dealer's stock. The defects found in these rods are of two types, involving (1) the character of the line of light and (2) the presence of prism acting to deflect the line of light from its true position.

The prism is readily detected by holding the rod before one eye so that a horizontal line of light is seen while the other eye looks at the light. The position of the line in relation to the light is observed. Then the rod is rotated through 180 degrees just as a cylinder is rotated in the trial-frame. The line is again horizontal and, if no prism is present, will be in exactly the same position in relation to the light as at the first observation.

The following table summarizes the data obtained from an inspection of these rods. No prism, less in amount than one half prism diopter, is recorded.

INSPECTION OF MADDOX MULTIPLE RED RODS.

No.	*Character of Line.*	*Amount of Prism Deflecting Line.*
1	Good	½ +
2	Indistinct	½
3	Good	None
4	Indistinct	½
5	Good	None
6	Indistinct	½ +
7	Indistinct	1
8	Good	None
9	Good	½
10	Indistinct	None
11	Indistinct	None
12	Good	½
13	Indistinct	½ +
14	Indistinct	None
15	Indistinct	1
16	Good	½
17	Good	None
18	Indistinct	½ +
19	Good	None
20	Good	None

It will be seen by reference to the table that ten multiple red rods (50%) formed a line of light defective in character and apt for this reason to give an inaccurate result in the test. Eleven rods (55%) contained an amount of prism ranging from one half to one prism diopter. Six rods (30%) were found to be free from all defects.

Ten single, clear glass rods were inspected and all but one found to form a line of light of acceptable character. The one exception formed an indistinct line, variable in width and of unequal density. No prism deflecting the line was found in any of these single rods.

An inquiry into the manufacture of multiple red rods was made for the purpose of learning why the product shows such a high percentage of defects. The various steps in the process are so little known outside the trade that the facts are briefly presented here.

Multiple red rods are manufactured from "ruby cane" which is supplied by the glass factory in strips eighteen to twenty-four inches long, ⅞ of an inch wide and about ¼ of an inch thick. The strips are made by a process of drawing and pressing which forms the well-known corrugations on one side and leaves the other flat. Red pot-glass is not used in making "ruby cane" because the variable thickness of the glass due to the corrugations would give a line of light of uneven red color. The glass factory has solved the problem by making "ruby cane" of clear glass which is flashed on the corrugated side. By this process the corrugations are covered with a thin film of red glass which gives the line of light a nearly uniform red color.

Pieces cut from the strips are optically ground and polished on the flat side and edged to size before being mounted. The corrugated side of the rod cannot be polished or finished in any way without removing the thin flashing from the high points, thus destroying the uniform color of the line of light. For this reason, all surface imperfections, resulting from the crude drawing and pressing processes, are allowed to remain on the corrugated side of the finished Maddox rod. It is to these imperfections chiefly that the defective character of the line of light is due.

The prism that is found in so many rods of this type is a result of imperfect workmanship during the process of finishing the flat side. The pieces of "ruby cane" are mounted with hot pitch, corrugated surface downward, on a stock or holder and then ground and polished on the flat side. If the corrugated side is not mounted in proper contact with the stock, the rod when finished will contain some prism.

The accuracy of the Maddox rod test is affected by the prism only when its base is so located that the line of light is deflected at a right angle to its direction.

The manufacture of multiple red rods involves several highly technical processes and the finished product is probably as good as can be expected. It should be possible to supply them free from any prism but the removal of optical defects from the corrugated surface is a problem that will not be easily solved. Some of the responsibility for the condition exposed in this report may be shifted to the popular demand for a colored multiple rod. The test can be accurately made with a clear glass multiple rod and a colored glass may be used with it if a colored line of light is desired.

Clear glass multiple rods are being manufactured from optical glass blanks, with the corrugations cut by a lap instead of being shaped by pressing and drawing. These rods are free from prism and form a line of light that cannot be criticized. They offer the best solution of the problem under discussion.

THE REMOVAL OF MAGNETIC FOREIGN BODIES FROM THE VITREOUS.[1]

By LEE MASTEN FRANCIS, M.D., Buffalo.

THE purpose of this paper is to formulate, if possible, some definite plan by which one may be guided in selecting a method and route in the extraction of magnetic foreign bodies from the vitreous and to set forth the intimate technique of the procedure, and in so doing bring out certain details not usually considered or assumed as being understood. It is not claimed that any of this is new or original, but in as much as surgical perfection is approached by the improvement of details, it is hoped that some of the steps may be helpful to others; but more especially that the presentation of this subject will stimulate a discussion, which will bring to the surface improvements in method which individual experience has proven useful.

It is assumed that the penetrating body has not carried with it infection and the discussion deals with eyeballs, which are in a fair way to be saved after the removal of the foreign substance.

Diagnosis.—Experience has repeatedly shown that the absence of a visible avenue of entrance is a thoroughly unreliable guide in the diagnosis of the presence of a foreign body in the globe, or if present, does the apparent path through the media, furnish reliable information as to its ultimate location, unless, of course, the body is plainly visible to the ophthalmoscope. In a similar way, the history is totally to be disregarded. I depreciate the use of the giant magnet as a means of diagnosis. The exposure of an eyeball to the giant magnet without previous knowledge as to the size, location, and position of the entering body, may do infinite and irreparable harm. Enough information cannot be gained to warrant the practice.

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[1] Read at meeting of American Academy of Ophthalmology and Oto-Laryngology, Cleveland, October, 1919.

The final diagnosis must rest with the Roentgenologist and to the Roentgenologist the suspected case should be sent promptly. How many exposures should be made? There is no set number, but enough to establish, not only the definite localization of the particle, but what is of equal importance, its several dimensions. It is quite obvious that photographs exposed in two planes only (as is usually done), cannot provide this information—always three and sometimes four are needed. Too much emphasis cannot be placed upon the necessity of knowing the three dimensions, for upon this knowledge must rest the rational selection of the method and route to be chosen for its extraction.

Route and Method.—In the selection of the route and method of extraction, the surgeon should be governed solely by the location, shape, and size of the foreign body.

It is obviously very difficult to lay down didactic rules for the selection of the best route and method for all cases. However, a rational may be indicated. That method and route should be selected, which shall produce the minimum of damage to essential ocular structures, and likely be most free from deleterious aftermath. If the invading body is small, roundish, and presents no ragged edges, which may become entangled in the wound or ciliary structures in processes of delivery, the anterior route by means of the giant magnet presents the least surgical risk. If, on the other hand, the foreign body is rectangular, though smooth, and too long to pass through the suspensary ligament, posterior chamber, and pupil, the scleral route is the one offering least risk. If the foreign body though small, presents ragged, irregular notches and facets which are likely to entangle and damage the structures through which it must pass to effect delivery, here again, the posterior route is the one of election.

Location.—Whatever the size and shape of the foreign body, if lying against the ciliary body in such a position that there is likelihood of its becoming impacted in the ciliary body upon exposure to the tractive force of a powerful magnet, this fact alone should urge the selection of the posterior route.

To Summarize.—The posterior route is preferable as offering the minimum of risk in all cases except those of small smooth foreign bodies not lying against the ciliary body.

OPERATIVE PROCEDURE.

General Considerations.—The patient should be prepared as for any major ocular surgical operation. This includes trimming of the eyelashes and wrapping the head in a sterile covering, preferably moist to prevent slipping. Both magnets should be covered with sterile jackets. For the giant magnet, a pillow slip with one corner cut out does well enough. This permits the operator to tilt and direct the magnet. A towel suffices for the hand magnet. These coverings should be secured by safety pins or tapes. The various magnet tips should be boiled or effectively sterilized. The magnets should be provided with a rheostat switch directly under the operator's control.

Instruments.—A non-magnetic speculum is essential for both routes and for the posterior route two non-magnetic forceps and two non-magnetic mosquito hæmostats are necessary. Nothing is more awkward or disconcerting than to have the instruments fly to the magnet when the current is turned on.

Illumination.—Good light is essential. Artificial light, owing to the ease of its control is best—some type of hand lamp so hooded as to illuminate the operative field and not dazzle the operator's eyes and in the hands of an intelligent nurse, is ideal.

Anterior Route.—Giant and hand magnets.

The pupil, having been dilated to its maximum and the eye cocainized, the patient is placed on a stool before the magnet. I prefer to sit facing patient as being the more comfortable position in which to manipulate and observe. Either the magnet is tilted or the patient's head is turned so as to cause traction in the line indicated by the radiograph. The patient is slowly brought nearer the magnet. As soon as the foreign body has passed through the suspensory ligament and its presence in the posterior chamber is evidenced by the bulging of the iris, the direction of magnetic pull must be immediately changed to one of obliquity so as to attract the fragment through the pupil. Continued exposure in the first position may impact the metal in the iris. When the foreign body has passed into the anterior chamber, the patient is removed to the operating table to complete the extraction by means of the hand magnet. By means of this magnet, the fragment is attracted to the upper quadrant of the anterior chamber near the contemplated incision. It is a mistake to draw the foreign body deep into the angle, out of sight, but it should be left near the base of the iris where plainly seen. From now on, it should be the chief aim of the surgeon to preserve the *aqueous as long as possible.* The anterior chamber is now opened with a keratome, promptly and in such a way as not to drain the aqueous. The keratome incision should not be at the level of the iris root but well above it, and directed nearly perpendicularly through the cornea in the direction of the fragment. The magnet tip is then applied to and not introduced into the wound. The assistant stands with the scissors ready to clip the iris should it through some mishap present. If the aqueous has been preserved, the fragment will glide promptly to the incision, where it can be delivered by the assistance of a fine forceps should the magnetic force be insufficient.

Posterior or Scleral Route with Hand Magnet.—The patient is placed on the operating table after the usual preparation made for any operation. The magnet is within ready access when needed. In addition to the usual anæsthesia obtained by the instillation of cocaine, a subconjunctival injection of a 1% cocaine and adrenalin solution is made at the site of the contemplated scleral opening. This insures not only good anæsthesia but a bloodless field. This incision should be planned to be made as near the foreign body as practicable, bearing in mind the avoidance of the ciliary body, and the insertions of the recti muscles, and in the lower quadrants rather than the upper. The bleb raised by the hypodermic is now seized with the forceps and a deep cut made in an antero-posterior direction with a bold stroke of the scissors. This cut includes conjunctiva, and subconjunctival tissue, exposing the sclera. The two flaps are now undermined for ten or more millimeters in either direction. A double-armed suture is now placed in the center of either flap incorporating a firm anchorage. These sutures are now secured by mosquito hæmostats and are used as retractors. The sclera is sponged free from hemorrhage and an incision is made through the sclera with a sharp, well-pointed von Graefe knife. The incision should be adequate for the delivery of the foreign body and in the direction of the retinal vessels, antero-posterior. The magnet is then presented to the wound. Meantime, the assistant stands ready with the scissors to trim away the choroid should it present. Upon the delivery of the foreign body, the wound is promptly closed by tucking one flap under the other and covering the first by the remaining flap, in such a way as to utilize the flaps as tractors approximating the lips of the scleral wound; and at the same time seal and reinforce the wound by a double layer of conjunctiva. This flap was described by me in 1913 in a paper before the Section on Ophthalmology, American Medical Association.

A further word concerning the conjunctival flap as described above. An important step in the technique is the provision made for closing the wound before making the scleral incision. This minimizes the danger of prolapse of vitreous through unnecessary manipulation with an open vitreous wound. In addition to this, the flaps furnish splendid retractors, making the exposure of the scleral wound sure and certain without the necessity of retraction of the conjunctiva by forceps, thereby cluttering up an operative field already too small. In many instances when not able to have trained assistants, I have allowed the weight of the hæmostats to retract the wound lips. With this in mind, it is well to have the threads long enough to permit the hæmostats to hang over the patient's face.

These wounds, in my experience, heal kindly and promptly. I have never seen a gaping scar or bulging cicatrix.

The after care of these patients requires no especial comment. As a routine, they are given sodium salicylate, forty grains daily, for a few days. The sutures are removed in six to eight days.

CONCLUSION.

Unreliability of Case Reports and Statistics.—One naturally turns to reported cases and statistics in seeking guidance for the selection of a satisfactory method for the removal of foreign bodies from the globe. I voice my personal opinion upon the value of such data by saying that they seem quite unreliable unless collaborated from cases which are similar in essential respects as to size, shape, and position of the foreign bodies and also to the amount of damage done upon entering the globe and the reaction they excite. The choice of an operative route seems more rationally to rest upon the selection of a method which will produce the smallest surgical trauma and do the least damage to essential structures. This, in turn, must depend, not upon a fixed procedure, but a procedure best adapted to the case in hand. I cannot be convinced that it is wisdom to drag an irregularly shaped, ragged piece of steel around the lens and through the pupil, and, on the other hand, I believe there is a minimum of risk involved by using this route for a small smooth fragment.

The purpose of this paper has been well served, if it has succeeded in pointing out some of the more essential points of technique, not frequently referred to, and has insisted that a given case should be weighed and estimated before the selection of an operative route or method.

REMARKS ON DIAGNOSIS AND TREATMENT OF LUETIC INVOLVEMENT OF THE OPTIC PATHWAYS.[1]

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INTRODUCTION.

I SHALL build my discussion on the subject of this paper around the following truisms:

(1) *The success of a treatment depends on* (*a*) *how accurately and early we make a diagnosis*, (*b*) *how well we know how to treat, and* (*c*) *how thoroughly the patient carries out instructions.*

(2) *Treatment will never equal prevention.* The second part of this paper reports on personal successes and failures in a series of cases of luetic involvement of the optic pathways.

I. EARLY DIAGNOSIS.

The subject of diagnosis of a disease of the optic pathways has progressed at a rate always in direct proportion with discoveries of new methods of examination of the visual apparatus. Our present means of establishing a diagnosis, though far from having reached a degree of ideal precision, constitute a pretty good armamentarium to furnish us more or less satisfactory information for an early diagnosis. And, yet, *early diagnosis of syphilis of the optic pathways is not made except in an infinitesimal percentage of cases.* Since the advent of the new era of scientific syphilography based upon the discovery of the spirochæta pallida, the routine examinations of the blood and spinal fluid and inoculations in animals, a number of facts of great importance to the clinician have been established.

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[1] Thesis for American Ophthalmological Society, 1919.

One is that *the entire organism is invaded by the spirochætæ already during the secondary stage of lues.* Another fact is that about *20 to 25 per cent. of syphilitics show evidence of an involvement of the central nervous system during the early stages of infection.* A third fact is that *syphilis active or latent is present in a large proportion of the human race.*

Having learned this lesson, ophthalmologists necessarily will have to ask themselves: How frequently and how early are the cranial nerves, concerning directly or indirectly our own specialty, involved by syphilis? How early should we attempt to detect this involvement? It is not necessary to argue on the importance of these questions. The very heart of ophthalmology is involved in them. Taking only one phase of the subject, the second cranial nerve, we are not prepared to answer to-day with any degree of accuracy how frequently and how early it is involved in syphilis. Studies on this question, made in the era preceding the new discoveries in syphilography, are only partially reliable, because the means of diagnosis of syphilis were insufficient. Nowadays, when we possess the means of demonstrating the presence of spirochætæ in the lesion and when we can make use of the five laboratory reactions, (blood Wassermann, spinal fluid Wassermann, cell count, Lange, and globulin) in addition to the old clinical examination, our diagnosis is more reliable and the answer to the above questions may be considered nearer to the truth.

How early should we attempt to detect an involvement of the second cranial nerve in a luetic? *As early as the primary lesion makes its appearance; and the examinations should be repeated at regular intervals during the entire time the patient is under the observation of the physician.* If this attitude would be taken by ophthalmologists a number of important changes would take place. In the first place we would obtain definite data regarding the earliest period and frequency of appearance, the types of optic nerve lesions, their course, prognosis, and types of response to treatment in patients diagnosticated as syphilitic *by our present methods.* In the second place we would do our share to stimulate the general practitioner and the syphilographers to watch the cranial nerves and particularly the second nerve from the very beginning of the infection (a thing which with very rare exceptions is not done).

In the third place we would gain valuable information regarding the future of the nervous system of that particular individual and we would be able to tell when to stop medication or to proceed with a new line of treatment. In the fourth place *it will prevent blindness.*

The conception of the words "early diagnosis" of syphilitic involvement of the visual pathways, as it was meant in the pre-scientific era of syphilography, was necessarily different than that we have to-day. Then, it meant the detection of fundus, perimetric, and other disturbances, as soon as the patient had some complaint about his vision, usually years after the infection had taken place. Now, it means *the search* (beginning already in the early secondary stage of lues) for symptoms and changes, possibly too slight to be noticed by the average patient. Then, the "early diagnosis" was in reality a "too late" diagnosis of very little practical importance, because the process was old and the changes advanced; now the early diagnosis is of great practical importance, because the process is searched and may be discovered at its inception when the changes may not be irremediable.

II. ACCURACY OF DIAGNOSIS.

There is no limit to the number of pitfalls we are exposed to, when we are called upon to make a diagnosis of a lesion of the optic pathways of syphilitic nature. *The first and most dangerous of all is the Wassermann blood test.* It has almost become an established tradition that a patient with, say, an optic neuritis or optic atrophy, and a 3 or 4 plus Wassermann blood reaction, must have a syphilitic optic nerve lesion. Nothing may be further from the truth than this, because: 1. One single blood test, made by one laboratory, can never be depended upon for a final decision. 2. The condition may be due to an entirely other cause than syphilis, although the patient may be syphilitic. 3. The condition may be due to syphilis plus one or several other causes. *One of the most difficult problems in medicine, and especially in ophthalmology and neurology, is the diagnosis of a non-syphilitic condition in a patient with syphilis.* From the therapeutic point of view the accuracy of the diagnosis may spell complete failure or success. The reports of the following two cases will suffice to make this point clear.

The first case is that published by Dr. A. Knapp (ARCHIVES OF OPHTHALMOLOGY, January, 1918). A patient thirty-six years of age, luetic with 4 plus Wassermann and bilateral partial optic atrophy, with vision progressively failing in spite of antisyphilitic treatment. Later on, X-ray of the skull reveals a bone absorption in the sella turcica and anterior fossa, suggesting the presence of a mass lying in the sellar region, partly in the anterior, partly in the middle fossa. The patient died after an exploratory operation and at postmortem was found a large epithelioma in the frontal lobe springing from the dura on the convexity and from the adjoining part of the falx.

My own case, a man fifty-four years of age, had been infected with lues in 1904 and began to notice failing vision in 1915. Blood Wassermann 4 plus; the diagnosis of progressive bilateral optic atrophy of luetic nature was made by one of the most distinguished ophthalmologists of this country and abroad and in spite of a careful and sustained antiluetic treatment vision continued to fail. When the patient came under my observation in June, 1917, he had a bilateral absolute central scotoma, vision right $\frac{15}{100}$, left $\frac{15}{70}$ with correction. A careful inquiry brought out a *history of excessive drinking and smoking*. The discontinuance of this abuse and the routine treatment with K. I. strychnin and hot baths improved vision to right $\frac{20}{100}$, left $\frac{20}{70}$, and reduced the large, absolute central scotoma in the right to a small, relative paracentral scotoma, which enabled him again to read with ease ordinary newspaper type. This case illustrates how easily a syphilitic patient may be condemned to antileutic treatment if he has a 4 plus Wassermann blood reaction. Here we had to deal with a toxic amblyopia (plus syphilis) which naturally did not yield to antiluetic treatment only.

A great stumbling block in the path of accurate diagnosis is the presence of another disease besides syphilis. In such cases the question immediately arises: "Is the visual lesion due to syphilis alone, to this other disease alone, or to both together?" A schematic summary of conditions, to be investigated as I desire to keep before my mind, is as follows:

First: Acute or chronic sepsis (from foci of infection in nasal sinuses, tonsils, ears, teeth, gall bladder, appendix, genitals, intestines, etc.).

Second: Acute or chronic toxæmias (disturbances of digestion, nutrition, and of elimination, of the endochrine system, lead, arsenic, alcohol, etc.)

Third: Acute or chronic trauma (emotional or physical, occupational; like aneurysms, empyema of nasal sinuses, periostitis of optic foramen, etc.)

Fourth: Heredity and congenital conditions. Only after having exhausted this sort of schematic plan of investigation (which is by no means an ideal one, as far as completeness is concerned) are we justified to say that the optic lesion, we are dealing with, is of purely syphilitic, of mixed, or of non-syphilitic nature. No matter how complex and almost hopelessly difficult such a search of the human organism appears to be, it cannot be denied that there is no other way of reaching an accurate diagnosis.

Leaving to the internist and other special workers the endless amount of clinical and laboratory work necessary for the elucidation of such a diagnosis, we should not be backward in adopting, as our own, new methods of examinations which contribute towards accuracy of diagnosis in ophthalmology.

THE SPINAL FLUID.

One of the most valuable additions to our diagnostic armamentarium of late years is the examination of the spinal fluid. The information furnished by this examination cannot be obtained in any other way. It has been definitely shown that the central nervous system is invaded very early at the beginning of the secondary stage of lues. Fordyce found that 20 to 25 per cent. of syphilitics show pathological changes of their spinal fluid during the first year of infection. H. Swift thinks that 33 per cent.; Ravaut that 67 per cent.; Gennerich even that 90 per cent. of syphilitics show changes of their spinal fluid during the early stage. The most characteristic evidence of the luetic invasion of the central nervous system is found in the examination of the spinal fluid. There are patients who have for years marked syphilitic changes of the spinal fluid and no clinical symptoms whatsoever. B. C. Corbus has seen six cases of primary lues, 33 per cent. of cases with secondary lues, and 40 per cent. of cases with tertiary lues with no neurological symptoms, but with very marked luetic changes of the spinal fluid. It is a frequent occurrence to find luetics with negative blood Wassermann and positive spinal fluid findings. Consequently, since the spinal fluid may show evidence of lues, not discoverable clinically or by blood examinations, since it shows changes during the earliest as well as in all stages of neuro-syphilis, even before the symptoms of neuro-lues make their appearance, we have to utilize the spinal puncture in every case of lues with manifestations in the central nervous system or cranial nerves.

The information we receive is definite:

(1) It shows us whether we deal with a luetic involvement of the central nervous system (negative spinal fluid in a non-treated patient is a strong evidence against it).

(2) It gives a clue as to about what pathological type of lesion of the optic path we are dealing with. The marked pleocytosis, the reducible plus Wassermann, and luetic Lange point to a meningitic process; the *non reducible* plus Wassermann fast, paretic Lange, absence of marked pleocytosis, and marked globulin increase to a parenchymatous process.

(3) It furnishes us a good deal of information about the prognosis, the parenchymatous type being very much more unfavorable than the meningitic or interstitial type.

REMARKS ON PROPHYLAXIS AND TREATMENT.

A few years ago prophylaxis of luetic involvement of the optic pathways meant only one thing: *avoiding the infection.* Now, since the early diagnosis of lues was made possible by Schaudin's discovery of the spirochætæ, we possess in the intensive and prompt treatment (abortive) one more means of preventing it from invading the central nervous system. A second and very important advance in the direction of prophylaxis during the last few years was made by the utilization of Quincke's method of spinal puncture. The routine examination of the spinal fluid of all the luetics in the early secondary stage points out to us those who have their central nervous system invaded. This class of patients, singled out at the beginning of their neuro-syphilis, get spinal attention and treatment until not only their blood but also their spinal fluid shows no more abnormal reactions. In this way we may arrest the process in its beginning and prevent serious damage to the central nervous system and optic pathways. In other words the treatment for the prevention of lues of the optic paths can have some hope of success only when the infection and the invasion of the nervous system are treated at the earliest possible moment.[1]

Having failed to prevent, the question to be considered next is:

How well do we understand the proper treatment of the optic pathways?

The answer is: As well as we know how to treat syphilis in general and that of the central nervous system in particular.

Does the treatment of neuro-lues differ in any manner from that of syphilis in any other part of the body?

Yes. The last few years have developed a new method of treatment of neuro-lues, consisting of intraspinal and intracranial medication in addition to the general anti-luetic treatment (salvarsan, mercury, and iodides.)

Is there unanimity of opinion among neurologists and syphilographers regarding the indications and efficacy of intraspinal and intracranial medication?

No. There are yet a large number among them who do not believe that intraspinal medication obtains results superior to the general treatment.

Which are the arguments advanced in favor of spinal medication?

First: There are cases of neuro-syphilis, like certain types of tabes and cerebrospinal lues, which do not improve either clinically, nor serologically, by general treatment, but which show rapid improvement during spinal medication.

Second: There are other cases of neuro-lues which improve during general treatment only up to a certain point, but get entirely well after the spinal medication.

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[1] Dr. I. Rosen, Chief of Clinic of the Department of Syphilis at the Vanderbilt Clinic, in a personal communication, told me that he has seen several cases of primary lesions (with demonstrable spirochætæ), which never developed secondary skin eruptions, blood or spinal fluid reactions. He thinks that prophylaxis of neuro-lues is possible in patients treated intensively while the infection is still in the primary stage.

Third: Other cases respond promptly to general treatment, but show frequent recurrences. These become entirely arrested by adding the spinal method of treatment.

Fourth: There are cases of neuro-lues which cannot stand mercury or salvarsan. They show anaphylactic or toxic symptoms, dermatitis, jaundice, etc. Such patients are entitled to spinal treatment and many of them do well with this method.

What reasons are advanced by those (like Sharp, Hammond, Wardner, and myself) who recommend intracranial medication of cerebrospinal lues in addition to general and spinal treatment?

There are cases which do not improve by general or spinal treatment and which are entitled to the application of the therapeutic agent, directly where the pathological process exists, in the cranium.

Why does the general treatment not act in some cases of syphilis of the brain or of the optic pathways?

Because the blood vessels and tissues surrounding them are impervious to medication.

Why, then, is spinal medication not sufficient in such cases?

Because: (1) In many there is a diffuse adhesive process between the meninges and spinal cord and brain. Spinal medication has no chance of diffusing into the spinal fluid and reaching the cranial contents.

(2) Even if there were no mechanical obstacles like exudates and adhesions to the diffusion of the medication upwards, my own experiments as well as those of others (Sharp, Tilney, etc.) have shown that fluids injected into the lower parts of the spinal canal do not extend into the cranial cavity beyond the medulla oblongata and pons, consequently they do not reach the region of the optic nerves.

If spinal medication does not reach the brain substance and optic nerves, how do we explain the good results obtained by this method in a certain number of luetic intracranial lesions?

My explanation is that *it is not so much the medication as the meningeal reaction, the active hyperæmia, which produces the beneficial effect.* In some cases this reaction extends all the way up to the brain and to the most anterior cranial nerves; in others it does not. In the former we get results; the latter need cranial treatment (in order to obtain the reaction in the tissues we wish to medicate).

Speaking from personal experience I can say that there is a group of cases with syphilis of the optic pathways which respond to spinal medication better than to general anti-luetic treatment alone.

To come down to the nucleus of the paper: what course is to be followed in a given case of luetic involvment of the optic pathways?

First: To make a strictly accurate diagnosis recognizing and eliminating or treating all the other factors which may cause the lesion.

Second: To ascertain that there is yet present an active process. End results of a condition which has come to a standstill need no treatment. A partial optic atrophy with no tendency to progress, with negative findings in the blood and spinal fluid, and no clinical evidence of an active neurological disease, should be watched but not treated.

Third: Patients with a vision to counting fingers at a few feet, with very poor fields of vision and atrophic optic disks should not be treated with considerable hope.

There remains the group of cases with $\frac{20}{200}$ vision or more with a fairly good field and in good general condition which belongs to the ophthalmological practice; these cases are to be treated according to the type of neuro-lues and type of optic nerve lesion they are affected with.

Therapeutically, it is of greatest importance to have a clear idea of:

(*a*) *Whether we deal with a tabo-paresis, cerebro-spinal lues, or vascular case;*

(*b*) *What type of optic pathway lesion the patient has;*

(*c*) *In what stage of lues the optic pathway became involved.*

The indications, the dosage, the frequency of treatments, and the method of administration are quite different not only in each type of neuro-lues, but also in each type of optic path lues.

For instance, in a case of papillœdema or papillitis occurring during a course of intravenous salvarsan injections, the indication is to continue persistently and cautiously with mercury and salvarsan; the condition clears up. If we stop, for fear of increasing the papillœdema, we run the danger of letting the syphilitic process go on unchecked to fatal termination (atrophy).

A case of optic neuritis in the secondary stage has to be treated along similar lines, possibly more energetically. The extent of the condition is greater, the sheaths of the nerves are usually primarily involved, and the question of spinal medication in addition to the general treatment has to be considered.

The optic neuritis, papillitis, and optic chiasm infiltrations of the tertiary stage are an entirely different therapeutic problem. Here we have to deal with the tissues, where a series of biologic changes took place during the years of symbiosis with the spirochætæ or their toxins. I fail to see how we could expect that this sort of modified strain of microörganisms should be attacked by salvarsan and mercury in the same manner as the fresh spirochætæ of the secondary stage. Neither could we expect that tissues, whose resistance to the toxins or spirochætæ has been gradually breaking down, or built up during years of struggle, should be readjusted by the same chemicals and methods as those tissues which are just at the beginning of the infection (primary and secondary stage).

We are in great need of knowing the exact indications for dosage, frequency, and method of administration of our therapeutic agents, and future experience will have to develop this knowledge. We need more than this. We need new methods and better therapeutic agents.

The retrobulbar neuritis type, very rare, would require not only the routine antispecific treatment, but also the serious consideration of a decompression operation, like trephining of the sheath of the optic nerve, if the course of the disease is seriously threatening a permanent extinction of the vision.

Finally the question of optic atrophies.

To my mind a clear understanding of the pathological condition which is causing the atrophy of the optic nerve is absolutely necessary in order to decide what therapeutic road to follow.

Cases of simple optic atrophies with a fulminant course are surely, a small but distinctive group. *There is not one minute's* *time to lose.* They are acute atrophies which absolutely refuse to respond to the old routine treatment. This group of acute optic atrophies are to be handled along entirely different lines than any of the other types of atrophies.

The optic atrophy with visible changes of the blood vessels on the disk and retina should have a different treatment; general medication, like small doses of salvarsan intravenously, gradually increasing doses of iodides over a long period of time and cautiously administered soluble salts of mercury injections, together with a special hygiene sparing the cardio-reno-vascular system and building up the general vitality.

Frank neuritic optic atrophies, originating from an optic meningitis need energetic general antisyphilitic treatment and also spinal, or, if necessary, cranial treatment.

As we see, it is therapeutically meaningless to say, "optic atrophy," without mentioning the kind of atrophy we are dealing with.

REPORT OF CASES.

The following cases are selected from a larger number and are reported here because they have been under observation for two to three years, a reasonable time to furnish an idea as to their course and termination. They represent the most frequent types mentioned in the first part of this paper: meningitic, interstitial, vascular, tabo-paretic and illustrate how little in some, how much in others therapeutic attempts may interfere with the march of the syphilitic process towards extinction of vision.

Case I.—January 23, 1917. Isy A., 35 years old, tailor. *Tabetic optic atrophy.*

Luetic infection fifteen years ago. Patient complains that the right eye is blind for the past five months and that the left eye began to blur a few weeks ago. Vision: right, counting fingers at three feet; left, $\frac{20}{30}$ +. Examination reveals both optic disks atrophic, pupils unequal, myotic, Argyll-Robertson. The spinal fluid had 50 cells, globulin +, Wassermann 4+ and a paretic curve (colloid gold reaction.)

Tongue deviates slightly to left, hypalgesia over both maleoli, Achilles reflex diminished left; absent right. Slight accentuation of the second aortic sound.

During the first two weeks of treatment with K. I., strychnin *Hg*, small doses of salvarsan intravenously and intraspinally the vision went down to "hand movement" in the poor eye and $\frac{3}{200}$ in the good eye. The field of vision was so much reduced that he had to be led around.

Under such desperate circumstances intracranial treatment was resorted to on February 15, 1917. The next few days after the treatment the vision diminished to only perception of light. The treatment with small intravenous and intracranial injections of salvarsan was kept up and the vision began to pick up so that four weeks after the first intracranial treatment he was able to call alone at my office from a distance of about twenty-five blocks and even went alone to the hospital changing cars and crossing very busy avenues. His field became larger and his acuity of vision on March 20, 1917, was $\frac{20}{200}$. But the improvement lasted only a few weeks. It began to deteriorate gradually and in April, 1917, we find him with V. O. S. $\frac{4}{200}$ and the following month with V. O. S. counting fingers at three feet. Later on he began to have generalized convulsions, his vision went down to zero in the left eye and hand movement in the right eye, and in December, 1918, he had to be taken to an asylum on account of mental disturbances. The findings in the spinal fluid were as follows:

	Cells.	*Globulin.*	*Wassermann.*	*Lange.*
1917, January 28.	50	+	++++	
1917, February 7.			++++ with 0.2 *c.c.*	paretic curve

Intracranial treatment begun on February 15, 1917.

1917, February 15.	50	+++	++++ 0.2*c.c.*	paretic
1917, March 12.	0	0	++++ 0.2	

The blood serum Wassermann remained 4 + throughout.

The fields of vision very much contracted above (to about 10° to 15°) from fixation point, gradually diminished until cranial treatment was administered, then improved for several weeks.

Remarks.—This patient is a tabo-paretic with an acute atrophic process in both optic nerves. The rapidity of diminution of vision in spite of and during the general treatment, the marked temporary improvement of the vision and of the general condition after the first cranial treatments and the final complete failure are the outstanding features.

Case II —Alb. B., 39 years old, insurance agent.

Tabes with bilateral simple optic atrophy. Luetic infection denied.

The right eye became blind during August–November, 1914, and the left eye began to fail sometime (?) later. In February, 1915, when he first came to the Eye Department, of the Vanderbilt Clinic, his vision in the left eye was $\frac{20}{100}$; glasses could not improve it; right eye, Vision—0. Examination on February, 1916, reveals bilateral simple, optic atrophy; rigidity of the pupils to light and to accommodation (?), absence of patellar reflexes, Achilles diminished. Field of vision, contracted concentrically to about 40 degrees all around with a marked indentation below and nasally.

Blood ++++ Wassermann, spinal fluid ++++.

16 cells, ± + globulin, luetic curve.

V. O. D. = 0; O. S. $\frac{15}{100}$.

After a course of thirty-one spinal injections of salvarsanized serum, eleven intravenous injections of salvarsan, twenty-one muscular of *Hg*, given during a period of about two years his vision was found $\frac{5}{100}$ and the patient complained that he feels his sight is diminishing steadily. The intracranial treatment was begun on February, 1917. He received three injections of salvarsanized serum, ½ to 1*m* gr. of salvarsan to the dose and his gradual loss of vision was arrested for about three months. Then it began to deteriorate again and in February, 1919, examination showed: Vision right and left—0. Mentally normal.

Blood and spinal fluid findings.

	Blood.	*Cells.*	*Globulin.*	*Wassermann.*	*Lange.*
1915.	4 +				
1916, Oct.	1 +	16	±	4 + 1*c.c.*	luetic curve
1916, Dec.		3	±	4 + 0.6*c.c.*	luetic
1917, Feb.				4 + 0.6*c.c.*	luetic
1917, Mar.				4 + 0.6*c.c.*	

The field of vision in the left eye contracted steadily first below and nasally, then, the temporal part of the field began to lose ground and this scotoma crossed first the point of fixation.

Remarks.—This patient is a tabetic who developed an acute process of optic atrophy losing rapidly the vision in the right eye. It seems that the process was twice temporarily arrested; first during the general and spinal treatment for about twenty-one months; second during the three months of cranial treatment.

CASE III.—Pet. K. Age 40. Cabinet maker. *Cerebrospinal lues; bilateral optic atrophy* (*neuritic.*)

Vision began to fail in the left eye sometime in August, 1915, and in the right eye a few months later. In December, 1915, he had to give up work on account of his poor sight. In his personal history we find; headaches, severe and continuous for three weeks, ten years ago; rheumatism in back and hands; wife had four miscarriages and one living child.

The examination (November, 1916) gives the following findings: Slight weakness of right side of the face, diminished reflex of left biceps, and both tricepses, poor coördination of arms (pointing finger to finger), absence of patellar reflexes, suspicious right Babinski, Oppenheim, and Gordon. Spinal fluid ++++ Wassermann (0.6); Lange, paretic; cells 4; globulin +++ V. O. D. hand movement above, temporally and nasally. O. S. L. P. pupils; unequal, moderately dilated, rigid to light and accommodation.

Fundus.—Bilateral optic atrophy (neuritic).

Treatment.—Having had K. I. and strychnin, *Hg* and salvarsan for more than one year before he came under my observation, without any change in vision, the intracranial treatment was decided upon. First treatment, November 21, 1916. The following cranial treatments were given on December 1st, December 19, 1916–February 1st, Mar. 14th, April 20, 1917. The vision began to improve slightly after the second injection when he could count fingers at five feet distance with his right eye and see "hand movement" with the left eye. His field improved so far as to give him the possibility of walking about in the room and in the street for some distance without bumping into objects. April 28, 1917: Vision, right counting fingers at four feet; left "hand movement." The vision remains slightly improved until September, 1917, when we find vision, right counting fingers at four feet; left counting fingers at one to two feet. Soon after the vision began again to fail and in November, 1918, he had vision, right "hand movement" at one foot; left "hand movement" at six inches. The field of vision, restricted to the upper, lower, and nasal parts, improved somewhat when the acuity of vision was better.

Spinal fluid and blood findings.

	Blood.	*Sp. Fl.*	*Cells.*	*Glob.*	*Wass.*	*Lange.*
May, 1916.	2 +		9		4 + 0.6*c.c.*	paretic
Nov. 1916.			4	3 +	4 + 0.6*c.c.*	paretic curve
Feb. 1917.			0	0		
April, 1917.			6	—		

Remarks.—This patient with cerebro-spinal lues and descending neuritic optic atrophy showed unmistakable signs of temporary, slight improvement after cranial subdural injections of salvarsanized serum.

Case IV.—L. Z. Age 33 years. *Cerebro-spinal lues, bilateral optic atrophy (neuritic) with marked retino-vascular changes.*

Left eye blind since October, 1915; the right eye began to fail gradually and steadily soon (?) after. History of chancre fifteen years ago. Loss of sexual power six months ago. Everything else in family and personal history, negative. Examination October 27, 1916, reveals: Vision, right, $\frac{10}{100}$, with correction $\frac{20}{100}$; left, "hand movement."

Pupils.—Small, irregular, unequal, rigid to light and accommodation.

Fundus.—Bilateral, simple optic atrophy with marked sclerosis of the retinal arteries.

Blood Wassermann ++++; spinal fluid Wassermann ++++ (0.2 *c.c.*); cells 14; globulin ++; Lange; paretic curve.

Course of vision and treatment.—After having received K. I. and *Hg* by mouth, eight spinal injections of salvarsanized serum, ten intravenous injections of salvarsan, and nine intramuscular injections of *Hg* his vision in the right eye was found slightly diminished to $\frac{15}{100}$ (with correction) and in the left eye, 0. The intracranial treatment was given, once, on February, 1917, and vision on March, 1917, was found $\frac{20}{70}$ in the right eye; nil in the left eye. The vision remained the same until June, when patient was taken to an asylum on account of sudden generalized convulsions and mental disturbance.

The field of vision contracted above and temporally, remained the same during the entire time the patient was under observation.

Blood and spinal fluid findings.

	Blood.	*Sp. Fl.*	*Cells.*	*Glob.*	*Wassermann.*	*Lange*
Oct., 1916.	4 +					
Nov. 4, 1916.			14	2 +	4 + 0.2*c.c.*	
Nov. 15, 1916.			30	3 +	4 + 0.6*c.c.*	paretic

Remarks.—This patient with cerebro-spinal lues and neuritic optic atrophy with marked retino-vascular changes showed a temporary improvement or at least an arrest of the process of degeneration of the optic fibers after the cranial treatment.

CASE V.—Rose Sol. 29 years old, cook. *Cerebro-spinal lues and simple optic atrophy with sclerosis of retinal blood vessels.*

Luetic infection, probably after marriage, twelve years ago. Vision began to fail in right eye in July, 1915. Came under observation in July, 1916, when vision was: R. $\frac{15}{200}$; L. $\frac{20}{20}$— with correction.

Neurological examination revealed: right knee jerk diminished; Achilles reflex weak on both sides.

Pupils unequal; Argyll-Robertson reaction.

Treated with strychnin and K. I. drops for six months, during which time the vision diminished to R. $\frac{5}{200}$; L. $\frac{20}{70}$. Received from January, 1917, four spinal injections of salvarsanized serum, four intravenous injections of 30*ct* grs. of salvarsan, each and four mercury intramuscular injections. The vision continued to fail during this treatment and at the end of the course we find her with V. R., L. P.; L., = $\frac{10}{200}$. Intracranial treatment on July 3, 1917; vision continues to diminish and about five months later all she saw was light perception.

The fields of vision were contracted concentrically to about 40 degrees all around in September, 1916. Then, during the next two months the right field retracted below to the horizontal meridian and temporally to the median vertical meridian, and finally vanished completely. The left field began to show two indentations, one above and temporally and one below and nasally, which became gradually deeper, but never met to separate the field in two islands.

The spinal fluid changes were as follows:

	Cells.	*Globulin.*	*Wassermann.*	*Lange.*
Dec., 1916.	50	+	4 + 0.4*c.c.*	paretic
Jan., 1917.	18	+	4 + 0.2*c.c.*	
Mar., 1917.	50	+	4 + 0.4*c.c.*	paretic curve.

The blood serum Wassermann remained 4 + throughout.

Remarks.—This patient became progressively worse, both during the old routine treatment with K. I. and strychnin and the newer method with spinal and cranial injections. The latter was used only once, because the patient set up a catarrhal jaundice which lasted a few months.

CASE VI.—Bess B. Age 33 years. Housework. *Tabes. Bilateral optic atrophy* (*meningitic*).

Came under my observation at the H. Knapp Memorial Eye Hospital on December 18, 1916, complaining that her vision began to fail in the right eye six months before and that the left eye is also failing lately very rapidly. A course of seven intravenous injections of salvarsan was given at another institution previous to calling at our clinic. Luetic infection soon after marriage several years ago.

Examination reveals: Absence of patellar and ankle reflexes, diminished wrist jerk, slight hypalgesia of both lower extremities.

Vision.—Right $\frac{20}{200}$; left $\frac{20}{50}$ not improved by glasses.

Pupils.—Irregular, unequal, slightly dilated, very sluggish to light and accommodation.

Fundus.—Both optic nerves grayish-white, atrophic (*optic atrophy from descending neuritis*).

After a course of six spinal injections, six Hg in the muscles, and six intravenous injections of salvarsan, we find her on May 10, 1917—Vision: right $\frac{20}{200}$, left $\frac{20}{40}$ + +.

The acuity of vision remained stationary up to December, 1918, when seen last. She could read Jaeger 1 with the left eye (adding + 1 sph. to her distance glasses) while she could not read ordinary print before the treatment started. The blood serum Wassermann was reduced from 4 + to 2 + and the spinal fluid findings were as follows:

	Cells.	*Globulin.*	*Wassermann.*	*Lange.*
Dec., 1916.	250	2 +	4 + 0.10*c.c.*	paretic curve
Jan., 1917.	40	2 +	4 + 0.2*c.c.*	paretic
Jan., 1918.	25	3 +	4 + 0.2*c.c.*	paretic

The fields of vision followed the usual course. The right field concentrically contracted showed also a marked indentation below and nasally which, however, disappeared almost entirely after a few spinal injections. The left field of vision slightly contracted (about 10–15 degrees) remained stationary during the entire period of about 2½ years, while she was under my observation.

Remarks.—This patient with tabes and meningitic descending optic atrophy has responded to the spinal treatment from the beginning. The exudative process having been resorbed, the failing vision was arrested and presumably some nerve fibers resumed their function, as evidenced by improvement of acuity of vision.

CASE VII.—Harry L. Age 40 years, electrician. *Tabes; gummatous infiltration in the region of the optic chiasm; descending bilateral optic atrophy.*

Came under my observation at the H. Knapp Memorial Eye Hospital in September, 1916, complaining of rapid failure of vision. Denies lues. Had been exposed to a strong electric flash seven years previously and says that his sight remained weaker ever since. But the left eye is blind since two years and the right eye is failing rapidly for the past five months.

The neurological examination revealed: slight incoördination of the right arm, markedly diminished reflexes of the wrist, biceps, triceps; absence of reflex knee jerks, and Achilles. X-ray skull negative.

Ophthalmological examination.

Vision.—Right $\frac{20}{50}$; left, "hand movement"; glasses do not improve.

Pupils.—Moderately dilated, unequal, irregular. Right sluggish to light and convergence; left rigid to both.

Fundus.—Right: apparently simple optic atrophy; sclerotic changes of some of the retinal arteries. Left: optic disk slightly raised and blurry above. Sclerotic changes of the retinal arteries near the disk.

Field of Vision.—Classical bitemporal hemianopsia.

Patient was admitted to the hospital and given a course of six small doses of salvarsan intravenously between September 20 and October 23, 1916. Also K. I. increasing doses up to 60 grains t. i. d. During this time his vision continued to fail and we find him in November, 1916, with $\frac{20}{200}$ right, hand movement left. From November, 1916, on, he began to get in addition to salvarsan and mercury spinal injections of salvarsanized serum. He received twelve intravenous of salvarsan, ten mercury, and seven spinal injections. The vision ceased to fail right after the first spinal treatment. Repeated examinations during 1917 and 1918 showed no signs of deterioration; and vision remained R. $\frac{20}{100}$; L. fingers at 2–3 feet (nasally).

Spinal fluid findings.

	Cells.	*Globulin.*	*Wassermann.*	*Lange.*
Nov., 1916.	0	± doubtful	4 + 1*c.c.*	luetic curve
Dec., 1916.	4	±	4 + 1*c.c.*	luetic
Jan., 1917.	3	±	4 + 1*c.c.*	luetic (weakly)

The blood serum 4 + Wassermann on September, 1916. The right field of vision showed complete temporal hemianopsia, but normal in extent in the seeing portion for all colors. The left field consisted of only a small remnant in the nasal lower portion seeing only hand movement, when patient first came under observation. Later on the field became larger but did not extend to the temporal side. The acuity of vision also increased to counting fingers at a distance of a few feet.

Remarks.—In this case, more than in any other, I have the feeling that the arrest of failing vision had something to do with the spinal treatment. To me it was a striking illustration how important it is not to go half heartedly about such cases. After having witnessed a reduction of vision from $\frac{20}{60}$ to $\frac{20}{200}$ + during a few weeks, while patient was undergoing the salvarsan course, it required quite an effort to decide to continue the salvarsan and add mercury and spinal injections to the treatment. I feel almost certain that this addition arrested the process. This consisted of an exudate in or gummatous infiltration of the chiasm, causing partly a blocking of its function and partly a degeneration of the fibers. The methods of reaching the chiasm by way of the blood stream alone were insufficient, but the spinal treatment must have caused a meningeal reaction extending up as far as the chiasm.

CASE VIII.—Anthony B. Age 60 years, colored. Hotel doorman. *Cerebrospinal lues; bilateral simple optic atrophy (descending neuritis).*

Referred by a physician to the H. Knapp Memorial Eye Hospital on January, 1917. Left eye blind for past three years; right eye failing for a few months.

Chancre without skin eruption thirty years ago. Neurological and general examinations—negative.

Ophthalmological examination.

Vision.—Right eye—$\frac{20}{40}$ with correction: left—0. Pupils slightly irregular, equal: right reacts to light and accommodation: left rigid to light, reacts to accommodation.

Fundus.—Optic atrophy (descending neuritis?).

After having five mercury injections and K. I. drops for a few months without succeeding in arresting the failing vision in the right eye he was referred to our clinic. Here he received a course of three spinal treatments, six intravenous injections of salvarsan, and six mercury between January and May, 1917.

His vision remained stationary (R.—$\frac{20}{40}$ L.—0) during 1917, and 1918. In February, 1919, when examined again he had R.—$\frac{20}{60}$ with his glasses, could read Jaeger 1 with an addition of a corresponding plus sphere. He had not received any treatment for more than one year and apparently some process of exudation must have taken place lately, which resulted in slight reduction in the acuity of vision.

The blood Wassermann was 4 + when first seen and the spinal fluid changes were as follows:

	Cells.	*Globulin.*	*Wassermann.*	*Lange.*
Jan., 1917.	50	3 +	4 +	
Feb., 1917.			4 + 0.2	paretic
Mar., 1917.			4 + 0.6	

The fields of vision slightly contracted for white, more contracted for red, showing an indentation of about 20 degrees above and temporally, remained the same in extent during the last two years.

Remarks.—This patient with both optic disks gray-white, completely blind in one eye, with beginning failure of vision in the other, responded to the combined treatment (spinal and general) and kept his vision intact for two years. Whether optic atrophies behave like this even when not treated or when treated by the old methods, is hard to say. My experience is too limited to affirm or deny this, and reports from literature are lacking in details of this kind. The process must have been a meningeal exudate since the spinal fluid contained a large number of cells and the treatment succeeded in causing resorption of the exudate. Its location must have been in the posterior portion of the optic nerve, sparing them acular bundle (which here is centrally located, very near the chiasm, as suggested by the beginning temporal hemianopsia, marked indentation of the field above and temporally).

CASE IX.—Harry Cash. Age 24; railroad engine fireman.

Diagnosis. *Lues (secondary stage) with bilateral papillœdema.*

Called at the H. Knapp Eye Memorial Hospital in September, 1914, complaining of blurriness of vision of the right eye. History of luetic infection in January, 1914. On examination (by late Dr. O. Schirmer) vision was found normal in each eye ($\frac{20}{15}$ —).

In December, 1916, he came back complaining of pains in the head and failing vision for one week. He had received eighty-five mercury and eighteen salvarsan injections since June, 1914. Vision was R.—$\frac{20}{30}$±; L.—$\frac{20}{25}$.

Fundus (examined by late Dr. Schirmer, Dr. Knapp, and myself). Marked papillœdema on both sides, considered by the first two distinguished examiners as a characteristic neuro-recidive. A course of spinal treatments in addition to a more cautious general treatment was outlined and carried through.

The vision varied during the following months in the right eye between $\frac{20}{30}$ ++ and $\frac{20}{70}$; in the left eye between $\frac{20}{30}$ ++ and $\frac{20}{50}$. The optic disks remained sometimes more, sometimes less bulging and œdematous.

By March, 1917, we find him with a vision greatly impaired (R.—$\frac{20}{70}$; L.—$\frac{20}{50}$.) He had received during the four preceding months nine spinal, eight mercury, fifteen salvarsan injections. Admitted to the hospital for rest, sweats, diet, and K. I. Condition same after four weeks. During the following six months vision gradually returned to $\frac{20}{30}$ ++ in the right eye and $\frac{20}{15}$ in the left. During these six months he received nine mercury and nine salvarsan injections and K. I. by mouth.

In April, 1918, we find him with a vision of $\frac{20}{20}$ + right; $\frac{20}{20}$ ++ left. The fundus examination shows, right, the optic disk congested, the retina adjoining it above nasally and below œdematous for a distance of about ½ disk diameter; left, distinct œdema of the retina adjoining the nasal portion of the disk, stretching over an area of about ¼ disk diameter; also a large floating opacity in the vitreous.

In September, 1918, the vision in the right eye was again $\frac{20}{100}$; in the left eye $\frac{20}{20}$. The right eye, according to the patient's statement, failed suddenly one week before calling.

Mercury inunctions for one month, and right eye recovered vision to $\frac{20}{30}$ −; left $\frac{20}{20}$. March, 1919, vision again $\frac{20}{50}$ right; $\frac{20}{20}$ left.

Blood and spinal fluid findings.

	Cells.	*Globulin.*	*Wassermann.*	*Lange.*	*Serum*
Dec. 7, 1916.	210	2 +	4 + 0.1*c.c.*	luetic	4 +
Dec. 21, 1916.	30	1 +	4 + 0.2	"	
Jan. 8, 1917.	10	2 +			
Jan. 17, 1917.	41	2 +	4 + 0.2	"	
Feb. 7, 1917.	8	2 +			
Feb. 14, 1917.	1	±	4 + 0.4		2 +
Feb. 23, 1917.			4 + 0.4		
Mar. 14, 1917.	15	±	4 + 0.2		
Aug., 1917.					4 +
Nov., 1917.					1 +
Sept., 1918.			4 + 0.4		1 +
Jan., 1919.					2 +

Repeated very careful neurological examinations—negative.

The fields of vision taken almost every month during the three years of observation showed marked variations as to their periphery, central and paracentral portions. At times the fields were moderately, concentrically contracted, at other times they showed several paracentral scotomata. The blind spots were constantly enlarged, the right much more than the left one.

Remarks.—The remarkable points about this case are:

(1) The numerous recurrences;

(2) The record of treatment (K. I., spinal, intravenous, and muscular injections) carefully administered with long periods of rest between;

(3) The absence of permanent damage to the optic fibers—in spite of the length of the process and repeated recurrences.

What is the condition we are dealing with in this patient?

Is it a papule-like process in the optic disks? Is it a gummatous process? Is it a nest of spirochætæ?

Papules, judging from the way they behave in the iris or other parts of the body, respond very readily to salvarsan and do not recur if treatment is kept up.

The repeated recurrences of the œdema of the head of the optic disks, the little damage done to the fibers, the persistency with which the Wassermann plus reaction recurred in the spinal fluid are very suggestive for the presence of a focus of spirochætæ in the optic disks. But of course this is only a presumption.

SUMMARY.

1. "Earliest" diagnosis versus late diagnosis of syphilitic involvement of the optic pathways is only possible by the routine, periodic ophthalmologic examination of every luetic from the very beginning of the infection throughout his entire life.

The earlier this is brought home to the general practitioner and syphilographer the sooner ophthalmologists have made a very valuable contribution to the practice of medicine.

2. The manner in which the subject of syphilitic optic neuritis and optic atrophies is treated in the classical text-books is more of a handicap against its proper understanding. This

chapter will have to be rewritten by the pen of a ophthalmologist interested in the neurological and syphilographic aspect of the subject.

The importance of this point of view is made patent by the consideration of the possibilities of making a more precise diagnosis and prognosis and mapping out clearer indications for treatment. Furthermore, it brings us nearer to the nucleus of the therapeutic problems concerning syphilis of the central nervous system and of the cranial nerves as a whole.

3. The few cases reported in this paper are selected to illustrate various types of luetic involvement of the optic pathways and their response or lack of response to the old and new methods of treatment. They suggest a number of interesting questions, like:

Why did they fall into the hands of the ophthalmologist years after the condition had started?

Why did many of them fail even after the ophthalmologist had them under treatment?

What is wrong with our present system of handling this class of patients?

Can part of it be remedied at the present time?

What is wrong with our methods of treatment, and what with our therapeutic agents?

Does the entire subject of syphilis of the central nervous system stand a chance of being rapidly advanced if the old, inefficient methods of study are continued?

Is it not time that special institutions should be established for the treatment and study of syphilis by complete teams of physicians and pathologists?

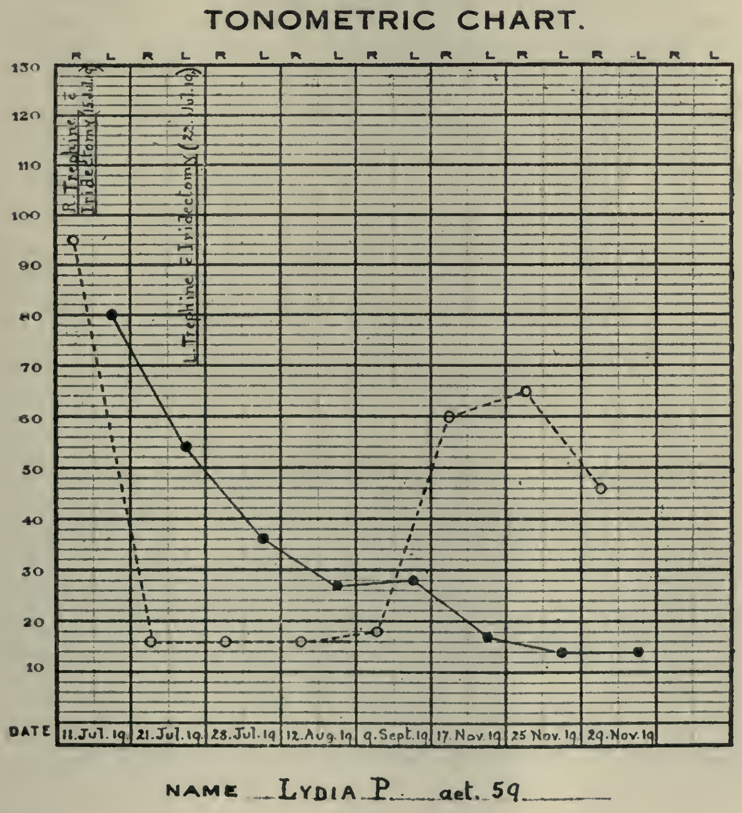
Is it within the sphere of ophthalmologists to take active part and take the lead in such a movement?

A TONOMETRIC CHART.

By Mr. T. HARRISON BUTLER, Birmingham, England.

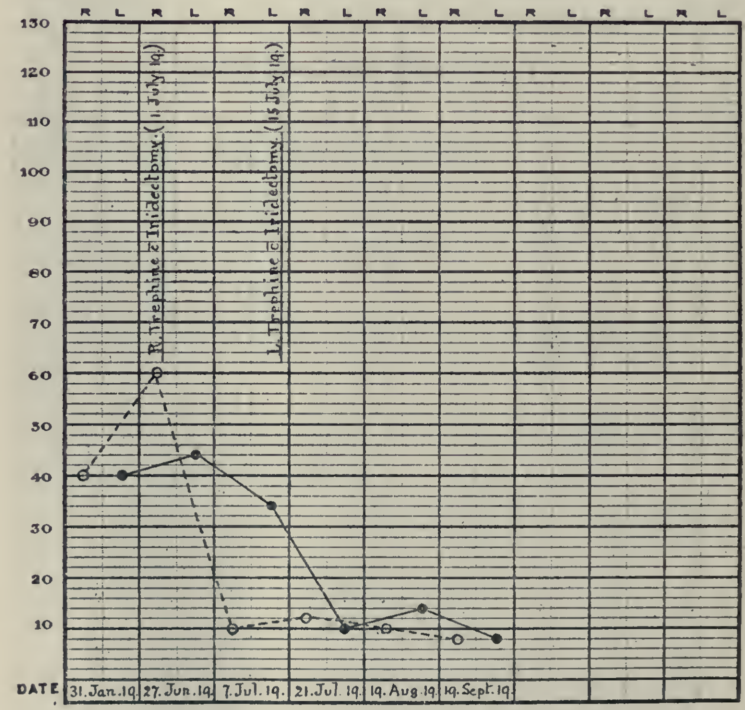
(*With two figures in the text.*)

I HAVE had the enclosed chart made to simplify the treatment of a case of glaucoma. These cases attend a hospital for a long time, and often appear after some considerable lapse



of time. To get a grip of the progress of the disease and of the effect of treatment it is necessary to read all the notes and to sort out the Schiotz readings, which may be entered haphazard all over the case-sheet. The chart shows at a glance the whole history of the patient, and is a great saving of time. I enter the tension of the right eye in red ink, that of the left in black. For the purpose of reproduction I have drawn the curve for the right eye in a pecked line. I am indebted to my house surgeon Mr. Sichel for drawing the curves. The charts may be obtained from Weiss of London.

TONOMETRIC CHART.



NAME Samuel S. aet. 71.

LETTER ON THE ROD SCREEN TEST.

By Mr. ERNEST E. MADDOX, Bournemouth, England.

Dear Dr. Knapp:

May I congratulate Captain Percival Dolman, M.C., on his admirable researches described in the September, 1919, number of these Archives, which I have taken for twenty years, into the "pros and cons" (and especially the "cons") of the rod test. It is always a pleasure to see a record of careful work, and I have no wish to show partiality to any test of my own. Indeed, it is probably impossible to have a test that is perfect all round. Perhaps I may be allowed to offer a few thoughts that bear on the matter.

Firstly, all tests for ocular balance divide themselves into two classes: (1) Monocular occlusion tests. (Screen tests, parallax, etc.) (2) Simultaneous vision tests. (Phorometers, erect prisms, glass rods, etc.) I have an impression that all the first group tend to display greater divergence (or less convergence) than the second group, for the reason that in the first case one eye only stands "to attention"; whereas in the second both so stand, though the fixing eye of course more than the other. The converging center, I think, is not so quiescent when both eyes are exposed, though dissociated, as when one is absolutely cut off. I have sometimes seen cases of exotropia in which the diverging eye, when covered by a screen, diverged several degrees further. The tonus of the converging center when both eyes are open, but dissociated, may be likened to the hum of a motor car at standstill. When one eye is occluded the hum becomes a little slower. The glass rod, therefore, in common with prism tests may be expected to show in many cases a trifle less convergence or more divergence than screen tests.

Secondly, I quite agree with Dr. Dolman that some patients, instead of projecting the streak of light to the distance of the spot of light, project it nearer to themselves. This may, as he suggests, tend to cause a slight convergence, stimulated by the apparent proximity of the line. I would go further, and say that, sometimes, even the point of light may appear nearer to the patient than it really is, especially in a totally dark room. In ordinary life we are accustomed to think light is distant in proportion to the mist which intervenes; hence it is natural to suppose a very bright light nearer to us than it really is, unless the objects about it are sufficiently visible to correct this impression. Dr. Dolman has wisely made his light not too bright, and I have always advised the room to be only partially darkened. To get the best effect of all, a point of light in the center of a square yard of velvet in a room sufficiently darkened to avoid bright reflections from objects in it, gives the best result. To ensure accommodation a series of small figures cut out of white paper may be gummed to the velvet at intervals of a centrad from each other. In measuring hyperphoria the rods may be considered quite truly since the converging center is a negligible factor.

Thirdly, the variability of the line of light is of two kinds. The tonus of the converging center is a fluctuating quantity, so that the eyes wander more or less when fusion is suspended, and the movements of the light streak merely portray this to the mind, and are indeed an expression of the fidelity of the test. Another class of irregular movements of the line, however, of an undesirable kind is due, as Dr. Dolman points out, to alternate fixation of the line, and of the point of light. To overcome this he rightly recommends screening the disk of rods, with brief unscreening at intervals. The following quotations from my former writings may be of interest. "In addition, therefore, to placing the rod before one eye, it is sometimes well to exclude that eye, and expose it momentarily, that the line of light may be seen in a position answering to the deviation on exclusion" (*Ocular Muscles*, 1898, p. 357). Again, "Should there be any suspicion that in spite of the dissimilarity of the images, the mind makes some slight attempt to unite them, the glass rods, while in position, should be screened with a visiting card, and the patient be instructed to state the position of the red streak at the first instant of its appearance following the sudden withdrawing of the card. In this way we really discover the position of an eye excluded from vision." (*Ophthalmoscope*, vol. x., p. 130.) I feel indebted to Dr. Dolman's investigation for indicating the desirability of doing this more frequently, or as a regular thing when very small departures from the normal require investigation. For considerable deviations it is unnecessary, though for the sake of uniformity, it might be well to use it always with aviators.

Fourthly, the rod test has been credited with a tendency to fusion by some authors. It has always seemed to me remarkably free from this, since the line will sometimes stand almost touching the point of light, with no tendency whatever to coincide with it; the same being true when an extremely weak prism is used to transfer the streak to the other side of the point of light. It is taken for granted that complementary colors are used for the two eyes, the rods being red and the glass before the other eye being deep green. For color-blind patients the one might be blue and the other yellow.

Fifthly, in my earliest experiments with the rods I was greatly impressed with their ability to demonstrate low degrees of anisometropia, as shown by the different reading obtained when the disks of rods are placed before each eye in turn. When the rods first came into being I recorded somewhere that sometimes so little as a quarter diopter of difference between the two eyes can be thus detected, so that we might make some use of this test after the correction of refraction, when there is reason to suspect that the eyes are not equally fully corrected; for this purpose the rod screen test would be most suitable.

Sixthly, the chief advantage of the rod test over the prism test (double prism excepted) is that the reading is not apparently affected by slight inaccuracies in the position of the rods or of the head. Phorometers, however, are set so well that they do not come into this comparison. As shown elsewhere, any complication introduced by co-existing cyclophoria is best met by the glass rod.

In Conclusion, the inaccuracies attributed by Dr. Dolman to the rods are all of a slight order which scarcely come into the range of ordinary practical work. They are practically "nil" in the measurement of hyperphoria. In practice we do not take much account of tiny horizontal deviations. For the competitive and comparative measurements of aviators, however, more strictness is essential, and here is the great value of Dr. Dolman's investigation. His recommendation of the more constant employment of the rod screen test for work of this kind is a distinct step in the right direction.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

The ordinary meeting of this Section was held on December 3d, the President, Mr. W. T. Holmes Spicer, occupying the chair.

Mr. G. Potts exhibited a boy who had severe **keratitis following upon an explosion of black powder.** The cheeks and eyes were scorched, the latter so badly that the sclera, cornea, and conjunctiva could not be separately distinguished. Under cocaine, the sclera and cornea were cleaned, and there remained a nebula of the left cornea, almost amounting to a leucoma. The case was now clearing up.

Mr. Potts next showed a case of **detached retina with an unusual condition of the conjunctiva.** In the spring of 1900 the patient contracted rheumatism while serving with the forces in the South African War, and since that date he had been subject to attacks of rheumatism at frequent intervals. His eye trouble appeared to date from 1914, his complaint then being of symptoms of iritis in the left eye. The right conjunctiva and sclera were thickened and œdematous, the sclera having a fatty appearance. The subconjunctival veins were somewhat dilated, and the pupil in each eye was tied down by posterior synechiæ. The man had myopic astigmatism. Vision, with glasses, right $\frac{6}{18}$, left $\frac{6}{9}$. He was put upon 10 grs. of iodide of potassium, but this caused colic, and neuritis in the legs. Four weeks ago he had iritis in the right eye, and the fundus could only with difficulty be made out; there was a hazy appearance of the lens. The pupil was contracted.

There was no history of injury or of syphilis, but a Wassermann reaction had not been done.

Dr. A. HUGH THOMPSON said he considered there was a distinct increase in intraocular tension, and this, taken in conjunction with the proptosis and the retinal detachment, pointed to the presence of a new growth, which he thought would prove to be tubercular.

The PRESIDENT said the case reminded him of some syphilitic cases he had seen.

Mr. MALCOLM HEPBURN showed a patient with an **aneurysmal varix of the cavernous sinus,** in order to ascertain whether anything further could be done. The common carotid had been tied, but noises in the head were still present and were a source of great trouble. Vision was not yet affected. The man's supraorbital vein was dilated, and he, the speaker, wondered whether it would be of any use to tie that.

Mr. CHARLES HIGGENS mentioned a case of his own in which the tying of a prominent vessel, not the jugular, cured the noises in the head, and the hemiplegia also present disappeared.

Mr. PERCY FLEMMING, as a result of the carotid being tied in five cases which had come under his notice, recommended that nothing further be done in this case unless the symptoms became more pronounced.

Mr. J. H. FISHER said that in some cases the carotid was injured when the base of the skull was fractured: in others the artery might burst spontaneously on account of the vessels being atheromatous. The treatment to be followed would differ according to which category the case belonged to. When ligation was done, it was very important to keep the patient at rest in bed for a long period afterwards; the present tendency was to discharge these cases from hospital too soon.

Mr. R. R. CRUISE related the procedures in the tying of successive vessels—unsuccessfully—in a very distressing case, in which the man felt life was insupportable.

Discussion on Dr. Batten's paper on "The Need for Ophthalmic Physicians for the Advancement of Ophthalmology."

Dr. C. O. HAWTHORNE, in opening the discussion on this contribution, reminded his hearers of his view that a considerable part of the work in the field of ophthalmology required not the art and craft of the surgeon, but the diagnostic and therapeutic methods of the physician. But he objected to the narrow title of "ophthalmic physician," just as he would object to be known as a non-ophthalmic physician. The physician's work was specially concerned with such conditions as ocular paralyses, pupil disturbances, cycloplegias, optic neuritis, optic atrophy, retinitis, and retinal and other intraocular hemorrhages. It was a mere accident that patients suffering from any of these states went first to either the ophthalmologist or the ophthalmic hospital. If the latter was to deal adequately with the kinds of cases he had mentioned, they must be well equipped for the purpose, and have the needed personnel. He did not see how the position Dr. Batten had taken up could be challenged; it concerned the good repute of the profession, the progress of scientific medicine, and the patient's welfare.

Mr. C. HIGGENS said the present practice was to refer patients sent to the oculist for an opinion to the proper specialist. Mr. W. LANG agreed.

Mr. ERNEST CLARKE averred that the remedy for the state of affairs alleged by Dr. Batten was to urge medical students who proposed to be ophthalmologists to learn more general medicine; there must be a broader range of education.

Mr. E. TREACHER COLLINS reminded the meeting of the history of Moorfields Hospital, in which there had been a gradual displacement of the physician by the surgeon since 1804. With the steady advancement of knowledge came the inevitable tendency to split it up into several departments; but there must be borderline cases, and these were liable to be overlooked by rigid workers in one or other specialty. Hence it would be an advantage for men to take up two departments, their position constituting a sort of liaison between the two. The dominant need was for the complete ophthalmologist: the man who was eager to know everything possible about any disease in which the eye could be affected.

Mr. ARTHUR W. ORMOND contended that, for appointments on the staffs of ophthalmic hospitals, the London M.D. should be equally eligible with the London M.S. He would, however, object to the division of the staffs into those who operated, and those who did not; the need was for a broadening of the specialty. Men must be allowed more time for the study of the medical side; at present the younger members of staffs were inundated with refraction work.

Mr. LEIGHTON DAVIES objected to the suggestion that the ophthalmic surgeon was incapable of investigating the conditions which resulted in eye troubles. It was a pity that men had to qualify in this special work after their general medical curriculum had ended, but it had the advantage of giving a wider general medical knowledge.

Professor J. H. PARSONS thought the chief value of Dr. Batten's paper was the stress it laid on the feeling which many ophthalmologists must have that they are not as fully able to deal with the medical as with the surgical aspect of their cases. He, the speaker, thought workers in the specialty ought also to render themselves competent to deal with physiological optics, and the relationship of ophthalmology to industrial conditions. He agreed with Mr. Collins's point, that workers in this field were ophthalmologists—neither physicians nor surgeons as such. For those who intended to enter the ophthalmic ranks, there must be provision for studying every branch, and the opportunities for such study must be greatly multiplied.

Dr. BATTEN, in a brief reply, said it was lamentable that many eyes should have been so badly operated upon, as they must be when men operated so seldom. Perhaps the main stimulus he had for writing the paper was the feeling that men who were not competent to operate properly should not have operations to do, and with the limited amount of operation material, it was not possible for every ophthalmologist to gain sufficient operation experience to ensure good work.

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. ELLICE M. ALGER, Secretary.

NOVEMBER 17, 1919. DR. ARNOLD KNAPP, CHAIRMAN.

REPORT OF CASES.

Dr. J. H. Claiborne, **retinal hemorrhage from intestinal intoxication with complete recovery after high lysis.**

The patient, male, 56 years old, after several weeks of over-indulgence in food and drink noted a sudden disturbance of vision in his left eye. Was seen on January 27, 1919, and the following condition was present. Right eye, myopia 12 D.; S. $\frac{20}{200}$. Interior normal. Left eye: S. $\frac{20}{40}$. There were several large hemorrhages about the disk. General arterial tension slightly elevated. Urine strongly acid, indican in excess, few hyaline casts, and many calcium oxalate crystals. Wassermann negative. Feces: highly acid, indol 5 +, bacteria gram. +. He was treated under Dr. Dwyer's direction with enemas and diet. On April 8th the sight was $\frac{20}{15}$; the hemorrhages are absorbed but the disk is pale.

It seems reasonable the same result might have been attained if the old methods of treatment had been employed, such as rest in bed, purgatives and iodide of potash, but at any rate, there can be no doubt that the importance of recognizing the intestinal tract as the seat of the cause of many affections of the ocular structures has not been exaggerated and that a fertile and wide field of investigation has been thereby opened. I take this chance to express my admiration and appreciation of the excellent work that Dr. Dwyer has done in this field.

Dr. C. W. STEVENS, **Trigeminal neuralgia** (appears in full in this issue).

DISCUSSION: Dr. ALLEN reported the case of a man who had epileptiform seizures, often two or three times a month, which had been completely relieved by an operation by Dr. Stevens. Dr. Allen thought that the examination of the eye muscles was very important.

Dr. TYSON asked what operation was performed by Dr. Stevens and whether there was any treatment other than the operation.

Dr. KNAPP asked in how many cases of fifth nerve neuralgia Dr. Stevens had found muscular trouble of the eyes.

Dr. STEVENS replied that the operations performed were of the kind designated as "extendo-contractions" of the recti muscles, in which the tendons of the muscles are released from their insertions and reattached to the eyeball in such a way as to induce a tilting of the vertical meridian of the eye without either lengthening or shortening the muscle and without injuring in any way the rotating ability of the muscles.

He also stated that nearly all his cases of trigeminal neuralgia had been referred to him by colleagues with supposed muscular anomalies of the eyes and that he had usually found these conditions to be present.

PAPER OF THE EVENING.

Dr. H. H. JANEWAY. **The therapeutic use of radium in ophthalmology.** Based on experience at the Memorial Hospital (appears in full in this issue.)

DISCUSSION. Dr. C. EVERETT FIELD: Our first radium applications in ophthalmic practice were made at the Radium Institute five years ago. About ninety cases have been treated to date. The results, in the main, have been encouraging and I am convinced that radium therapy should be classed as an essential adjunct.

Radium often prepares the way for operation and where the knife is elected, we may hope to check metastasis by the prophylactic use of radium. The eye and adjacent tissues are powerfully resistant to radium, and there remains little danger of harmful effects. Radium offers many advantages over X-ray. Aside from its routine use for malignant conditions threatening the eye, we have been favorably impressed with the results of radium for the treatment of vernal catarrh, corneal ulcers, and in a few cases of cataract. Our experience has been confined to the use of radium element in the form of tubes and surface applicators. We are not fully informed as to the technic of use of active deposit and hesitate to endorse the wide field active deposit applicator to be slipped under the lid for the treatment of vernal catarrh.

It is a well known fact that this condition manifests itself in patches of false membrane which should require the localized direct action of radium.

During the last four years, we have treated about twenty-five cases of vernal catarrh. Relief has occurred in all of our cases and I believe every case can be helped. A cure, however, should not be claimed until the second summer has been passed. We have had five cases of cataract and in these the application has controlled the process, improved vision, but no cure is reported.

In vernal catarrh, our treatments require the use of twenty-five milligrams of radium, applied with .5*mm* gold screen for a period of nine to twelve minutes every third week. Three radiations usually are classed as a series. Relief is afforded by the first application.

Corneal ulcers receive a dosage by direct application with a 2 milligram tube for a period of four to six minutes. Three cases during the past year, that resisted all other treatment, responded favorably to radium.

Our treatment of cataract has been of two types: The direct application of 25 milligrams just free of the surface of the eye for a period of four to nine minutes. More recently we have favored the dosage advocated by Levin, namely 25 milligrams with a distance screen of ½″ applied for one hour. Treatments as here indicated should be inaugurated by the ophthalmologist at our various hospitals receiving eye cases and should not be sent to radium institutes. Good work in ophthalmology could be accomplished with a radium applicator to cost from $600 to $1000.

Where malignancy is a part of the diagnosis, such cases should be referred at once to the cancer specialist, familiar with radium therapy. The wide range of screenage and dosage to properly attack cancer or to exert prophylaxis requires the knowledge of an expert diagnostician, who is a deep student of pathology and physics.

Dr. Isaac Levin: I enjoyed listening to Dr. Janeway's excellent presentation of his pioneer work at the Memorial Hospital.

The general technic of radium-therapy on cancer is very similar, whatever the organ involved. Nevertheless, the eyeball differs from all other organs, on account of its size and anatomical construction, and it presents the most simple organ in the body to treat with radium. Radium-therapy is applied in two ways: superficial and deep. In the deep, the rays pass through a layer of normal tissues before they reach the diseased part. In the superficial, the application is made directly on to the diseased surface. While the latter method, with comparatively soft rays and little filtration, may be used in the treatment of conditions like corneal ulcers, generally speaking, methods of deeper therapy should be employed in all diseases of the eye.

In vernal catarrh, in my opinion, the ultimate result is not very satisfactory, since notwithstanding the temporary disappearance of the conjunctival abnormalities, the process continues in its course. I have had six cases of vernal catarrh, which were all improved. I fear, however, that the condition recurred subsequently in all the cases treated.

As to the results in cataracts, I do not know yet whether permanent therapeutic results were obtained, but some distinct biologic influence was exerted on a sufficiently large number of cases to make it worth while to continue the work. We have proven that with the hard, deep, penetrating, well filtered rays used in proper quantity, no injury can be done to the normal structures of the eye. I have repeatedly placed large quantities of radium directly over the orbit, leaving them in place for twenty hours at a stretch, without causing any damage to the eye. As I stated above, radium application to the eye is simple, and comparatively small quantities are required. Every ophthalmologist can learn easily to apply this method of treatment. It is well worth while to test it for a few years and thus obtain a correct estimation of its value.

Dr. John E. Weeks: I will briefly refer to a few of the cases that Dr. Janeway has treated at my suggestion. The first was a case of double glioma of the retina. One eye was removed. In the remaining eye, the tumor was not large, measuring between two and three disk diameters. After the first two applications of radium, the growth seemed to be retarded; then however it went on advancing, notwithstanding five additional applications. The patient died two weeks ago, after having been under observation for two years.

I have had the privilege of looking at the case reported by Dr. Schoenberg on two occasions. It seems to me that there has been a recession of the growth, an apparent arrest and shrinkage.

As to vernal catarrh, my experience is limited to one case in which the symptoms improved, but recurred the summer after. In the case presented here this evening, although the conjunctiva is quite smooth, the disease is not cured by any means. The results in two other cases which I have seen were very gratifying, but they had not completely recovered.

In regard to cataract, as the condition is due to a degeneration of the lens tissue, I do not see how cataract can be dissipated by the use of radium. If the nutrition of the lens can be increased, it may be possible to clear up some of the haziness due to the presence of turbid fluids, but we cannot restore degenerated lens fibers by the use of any agent.

In two cases of epithelioma of the ocular conjunctiva in which recurrences had taken place after excision, apparent cures were effected by the use of radium. In two cases of epithelioma of the eyelids radium was most efficient. In no case have I seen injury to the globe as a result of the use of either radium or the X-ray.

Dr. M. J. Schoenberg: I deem this an opportune moment to relate my experiences concerning some ophthalmological complications arising as a result of radium-therapy.

Burns of the lids, bulbar conjunctiva, and cornea, also loss of lashes and lenticular opacities have come under my observation following the applications of radium as a therapeutic measure.

The burn of the bulbar conjunctiva presented the appearance of a thick, white, glossy porcelain-looking patch upon a patient treated with radium for vernal catarrh. This same patch remained unchanged for nearly one year. Two other patients treated likewise presented corneal burns of both eyes, consisting of numerous foci of denuded superficial epithelium causing the patient considerable annoyance (photophobia, lacrimation, and pain) over a period exceeding three months.

Concerning the lenticular opacities—they appeared in my little patient with glioma of the retina following a few radium applications. Axenfeld has seen a similar case. Whether these opacities of the lens are due to the intraocular disturbance or really caused by the radium-therapy, we are not as yet prepared to say. However it is reasonable to believe that the lens of a child is unable to withstand radium-therapy with the same impunity as the adult.

In my second patient with glioma of the retina I wish to emphasize the fact that there were no chorioretinal changes, whereas in my first case of glioma there developed a ring of chorioretinitis surrounding the gliomatous mass; these findings may suggest an explanation for the radium acting favorably in one case and not at all in the other. There is a possibility of the area of chorioretinitis developed during the course of treatment having acted as a barrier to the extension and further spreading of the new growth.

Dr. KNAPP: There is one point which I think Dr. Janeway has not sufficiently emphasized. I believe it is his firm opinion that the efficacy of radium depends upon the administration of a single large dose. I hope Dr. Janeway will enlarge upon this. I should also like to ask him whether the eye cannot be regarded as being unusually tolerant.

Dr. JANEWAY: It is very important to use a single large dose in the treatment of malignant tumors. Success in the treatment of cancer depends greatly on the adjustment of the dose to the lesion in a way which will produce the maximum effect in one sitting. In doing this, injury to the normal tissues must be avoided and in our experience can be avoided in applying a single large dose. I feel that the eye is responsive and at the same time tolerant to radium. Injuries such as possibly development of cataract are not yet well understood. The retina is surely a tissue which is susceptible to these radiations, possibly more so than we believe.

I am glad that Dr. Weeks called attention to the fact that we should not classify cases of vernal catarrh as cures. At the same time, I am very firmly impressed with the improvements which have occurred in our cases. Bad complications such as burns are inexcusable. They are due to faulty technic which is only justified in the earliest days of a new method of treatment.

OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM.

PRESIDENT: J. B. STORY, P.R.C.S.I.

ANNUAL CONGRESS, 1920

The next Annual Congress of the Society will be held on Thursday, Friday, and Saturday, 29th and 30th of April and 1st of May, 1920.

The arrangements will be as follows:

THURSDAY, APRIL 29th.

MORNING.	**At the Royal Society of Medicine, 1, Wimpole Street, W. 1.**
10 A.M. to 12.30 P.M. ...	**President's Opening Address.** Papers.
AFTERNOON.	**At the Royal London Ophthalmic Hospital, City Road, E.C. 1.**
3 P.M.	Clinical Meeting. Exhibit of books, museum specimens, drawings and portraits belonging to the Hospital. Members will dine together in the evening.

FRIDAY, APRIL 30th.

At the Royal Society of Medicine, 1, Wimpole Street, W. 1.

10 A.M. ... ... Discussion on "Diabetes in Relation to Diseases of the Eye." To be opened by Sir Archibald Garrod, Mr. R. Foster Moore, and Dr. E. Spriggs. The following also intend to speak: Dr. Leyton, Mr. G. Mackay, Dr. Poynton, Mr. P. H. Adams, Dr. Cammidge, Mr. Gray Clegg, and Dr. A. Renshaw.

5.30 P.M. ... ... Business Meeting.

8.30 P.M. ... ... Papers.

SATURDAY, MAY 1st.

10 A.M. ... ... **Visit to St. Margaret's Hospital, Leighton Road, N. W. 5, the Special Hospital of the Metropolitan Asylums Board for cases of Ophthalmia Neonatorum.**

Discussion on "The Prevention and Treatment of Ophthalmia Neonatorum." To be opened by Dr. Gibbon Fitzgibbon, Master of the Rotunda Hospital, and Mr. M. S. Mayou. The following intend to speak: Mrs. Scharlieb, Dr. Macrory, Messrs. Sydney Stephenson, Maitland Ramsay, and J. Wharton.

Members desirous of reading Papers, showing Cases, or taking part in the Discussions, are requested to communicate as soon as possible with Mr. F. A. JULER, 24, Cavendish Square, London, W. 1.

Papers and Communications, subject to the judgment of the Council, will be printed in full in the "Transactions."

Under the By-laws readers of Papers must not exceed twenty minutes, subsequent speakers ten minutes. The openers of the Discussions are allowed twenty minutes.

All Communications must be typewritten.

R. R. JAMES } *Hon. Secs.*
F. A. JULER }

Vol. XLIX. No. 3.

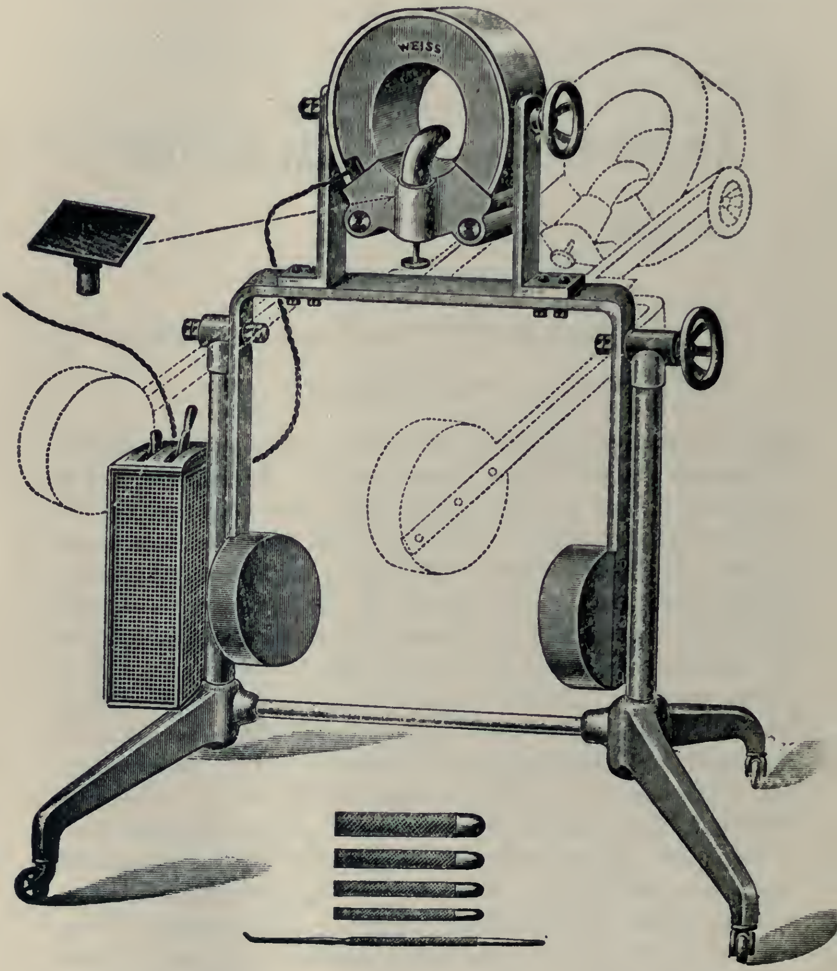
ARCHIVES OF OPHTHALMOLOGY.

THE RING MAGNET.

By Mr. T. HARRISON BUTLER, Birmingham, England.

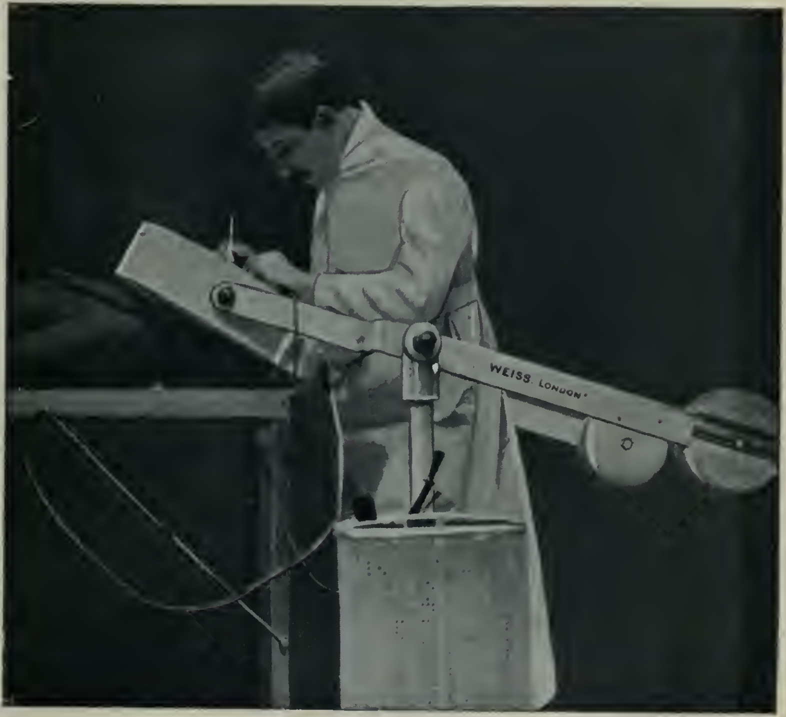
(*With two figures in the text and Text-Plate XII.*)

IN 1909 my attention was directed to the ring or *Innenpolmagnet* by reading a paper by Otto Schirmer in which he recounted his practical experience with the instrument. Further investigation convinced me that Mellinger had made a great advance upon previous methods for removing magnetizable fragments from the interior of the eye. At about this time the Committee of the Coventry General Hospital decided to install a giant magnet, and provided me with a Mellinger *Innenpolmagnet.* Coventry is a manufacturing town of 120,000 inhabitants, and in the Eye-Department of the hospital I have frequently to deal with cases in which an iron or steel splinter has struck the eye, and may have lodged therein. Before I obtained a giant magnet I treated some of these patients with Snell's hand-magnet and extracted splinters from the anterior segment of the globe. Others I sent to Birmingham to be operated upon by the Haab magnet. The Coventry Ring Magnet was the second of its kind installed in England, another being already in use at Newcastle-on-Tyne. My magnet was mounted on a pedestal. It proved highly successful, but had the disadvantage shared with the Haab and others, that the patient had to sit on a stool during the operation. Three years ago it was remounted, and is now used over a patient lying upon the operating table. This change has enormously increased its usefulness. In 1916 the Haab, which had for many years rendered valuable service at the Birmingham Eye Hospital was beginning to show signs of defective insulation, and it was supplemented by a ring magnet of the latest pattern. For the past three years as surgeon to this hospital I have had the advantage of working with both these magnets, the *Innenpol* and the Haab, and have been able to compare the two. I described the ring magnet in a paper read to the



Arch. of Ophth., Vol. XLIX., No. 3. *Text-Plate XII.*

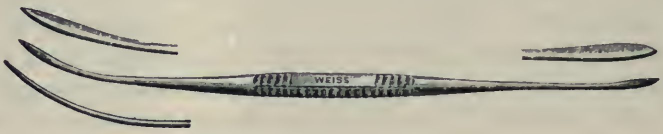
ILLUSTRATING MR. T. HARRISON BUTLER'S ARTICLE, "THE RING MAGNET."



Midland Ophthalmological Society in October, 1916. My excuse for reverting to the subject is that the ring magnet is still not so well known as its excellency warrants, and that the experience of the past three years has furnished me with new facts which have modified some of the views I held in 1916. During the period covered by the war several ring magnets have been brought into use in England. One is installed at the Royal London Ophthalmic Hospital (Moorfields); there are others in London and in the provincial towns of England. The instrument was used in France in the Military Ophthalmic centers, and some have been sent to the colonies. Messrs. Weiss and Son of London tell me that they have sold twenty-one ring magnets since 1916, and in the same period have only received an order for one Haab. In fact the Mellinger magnet is rapidly displacing the Haab type in the British Isles and the British Colonies. Up to the present I know of no case where an ophthalmic surgeon who has mastered the technique of the ring magnet has any desire to return to the older types of giant magnet. There seems to be considerable misapprehension of the exact nature of the Mellinger magnet. Thus one writer in a recent paper speaks of the enormous power of this magnet and of spatulas being connected to it. As a matter of fact the ring has about the same or even less power than the older types, and none of the instruments are connected to it with the exception of the horn, which is best held in the hand, and not placed in its socket.

The ring or internal pole magnet (*Innenpolmagnet*) is not actually a magnet but an apparatus for creating a magnetic field. It is a scleroid, and depends upon the fact that when a current of electricity flows round a coil of wire it induces a homogeneous magnetic field within it. If the number of coils be increased the strength of the field is increased, in fact the magnetic force at the center of the ring is expressed by the formula: $F = \frac{2 \pi ni 2}{10 r}$ where $n =$ the number of coils $i =$ the current in absolute units, and $r =$ the radius of the coils. Such a scleroid has an N and an S pole and acts in all respects as a magnet. If a coil of soft iron be placed within the coil the magnetic field is greatly intensified. If a rod of iron be approached to the coil it is strongly attracted towards its center.

It resists displacement in either direction, tending to remain in the center of the coil. This fact is of great importance in the practical use of the machine. As will be seen from the illustrations, Mellinger's magnet consists of an oval iron case like a small horse-collar containing about a mile of insulated copper wire. The exact length and the gauge of wire employed depends upon the voltage of the current supplied. The ampèrage developed is too large to be carried by the ordinary wiring used for illumination, a special main must be laid down. The ring is mounted by trunnions on a balanced frame, which allows it to be fitted over the head of a recumbent patient. The later patterns of the instrument are furnished with a detachable socket to hold the horn and with a rheostat to vary the strength of the current. Both are quite unnecessary, and I never use them. The magnetic force is dosed by the size of rod chosen, and the horn is best held in the hand; in fact it is very unsafe to use it in the orthodox way, for when it is fixed to the ring and approached to the eye the slightest movement of the frame might cause the sharp point of the horn to damage the globe. Naturally a continuous current must be employed. If an alternating current is supplied by the town it must be rectified by an alternate current motor and a continuous current dynamo. There are fluid rectifiers on the market, but I believe that they are unsatisfactory. The Volkmann magnet used at the Hôtel Dieu in Paris is supplied with a continuous current from a mercury vapor lamp rectifier. A case of soft iron rods of graduated sizes, a spatula, and a massive horn are furnished with the ring magnet. In my original paper I described a small spatula which is easy to introduce within the eye. I have not found it as effective as I had anticipated because its mass is not sufficient to hold enough magnetism to exert useful tractive force.



Before the patient is brought to the magnet the eye must be cocainized and the pupil fully dilated with atropine. I have never so far had to administer a general anæsthetic. He is now placed upon the table with his head raised upon a small pillow, and the ring is lowered over his head which is so adjusted that the injured eye is situated in the center of the ring. Except under exceptional circumstances I adopt the well known Haab *technique*. The current is turned on, and here I would emphasize the necessity that either the surgeon himself should manipulate the switch, or that it should only be shut or opened at his command. If the surgeon is holding one of the large rods near the ring and the current be suddenly switched on without his knowledge, the rod will be drawn suddenly to the center of the ring and may badly bruise the patient's eye. The current now flowing magnetizes the steel fragment in the eye and also any iron rod which the surgeon may bring within its magnetic field. The patient is directed to look at a point or lamp in the ceiling and the smallest rod is held perpendicularly over the eye and gradually approached till it nearly touches the apex of the cornea. A larger rod is used, and yet a larger, till eventually the fragment is seen either behind the iris or in the anterior chamber. If behind the iris, a small rod is taken and applied laterally to disengage the fragment from under the iris. With care and perseverance this can generally be successfully accomplished. When the fragment has been drawn into the anterior chamber the current is turned off, and with the ring still *in sitû* a keratome incision, not too small, is made in the cornea at a spot about one third of the distance from limbus to apex. The incision must be carefully made so as not to lose the aqueous. If aqueous should escape it is necessary to wait for it to reform, or to inject some normal saline to take its place. Now switch on the current and take up the large spatula. With this the fragment is drawn to the wound by stroking the spatula over the corneal surface in the required direction. When the fragment reaches the wound it generally flies to the spatula. Only occasionally is it necessary to introduce the small spatula within the eye to disentangle the fragment from the iris. The small spatula may not have enough tractive force and the large one may be called for. In case the largest rod fails to bring the fragment to the surface the horn must be used. Hold it in both hands, place its heel against the ring case which strongly attracts it, and gently lower the point to the eye. It must be held firmly for the pull to the center is considerable and must be resisted. All the rods must be grasped firmly. They have a milled ring to give the fingers a good grip. This inward pull is at first an inconvenience but it is soon allowed for and ceases to trouble the operator. If after repeated application the horn fail, then the patient must be brought to the Haab magnet if one is to hand. The tractive force of a good Haab with blunt point is generally greater than that of the Mellinger. In my last paper I stated that I had never succeeded with the Haab when the ring had failed. During the past two years I have twice brought a fragment to the surface when every effort with the ***innenpol*** had been fruitless, and one of my colleagues has had a similar experience. If both fail, and X-rays reveal the presence of a fragment within the globe, send the patient back to bed and try again next day. In one case I succeeded in extracting a small spicule a week after both magnets had been employed with no result. I would even try a third time, and make a prolonged effort using the horn in all directions. There are some cases when the posterior route will be chosen. If there be a large wound in the posterior segment of the eye it is only common sense to try to remove the fragment by the way it entered. The rods can be sterilized in a spirit lamp flame and placed actually on the wound. When every effort has failed, and only then, it is justifiable to introduce the large spatula into the vitreous chamber. Once I succeeded in this way and the eye retained useful vision. In my former paper I spoke of the danger of dragging the fragment through the lens. Sir William Lister tells me that as far as he knows this has never happened, and he believes could not happen. In a wonderful way the fragments glide over the posterior capsule, pass the zonule of Zinn and appear in front of the lens.

The prognosis of these cases has been ably worked out by several authors: it is sufficient to say that it depends in the main upon three factors: the asepticity of the fragments; their size; and the most vital question of all, has the lens been wounded? If the fragments be small and the lens is untouched, then the prognosis is good.

The final subject is the comparison between the Haab pattern and the ring magnet.

We may at once dispose of the one outstanding advantage of the Haab type; they are apparently more powerful. This has been proved clinically: as stated above, some splinters have been brought forward by the Haab when they resisted the seductions of the ring. We made tests with the magnetic fluxmeter which showed that the Haab at the Birmingham Eye Hospital, which is old and imperfect, was more powerful than the new Mellinger magnet. Sir William Lister conducted experiments which measured the actual mechanical pull of the magnets. He found that the newest Haab with a blunt point was considerably more powerful than an English made internal pole magnet. E. Hertel (3) comes to a different conclusion. He measured the distance from which a steel ball was attracted by various magnets. The figures were as follows: Schumann's large magnet 125; Mellinger's 103; Schumann's small magnet 92; Volkmann's 77.5; Haab's 76; Payr's 76; Schösser's 46. Hertel gives other tests and in all of them Mellinger's magnet appears to be one of the most powerful, and considerably more so than the Haab. It would therefore appear that the apparent superiority of the Haab is open to question, so we may conclude that in any case the difference is not very material and probably different specimens of the various magnets vary considerably in magnetic strength. Practically the Mellinger ring has ample power and it is only very occasionally that one wishes for more actual pull. A practical test shows that the magnetic force is enormous. If the horn be placed in its socket, and the largest rod placed in contact with it, it will be found impossible to separate the two by a steady pull when the whole current is passing round the solenoid. It can be done by jerking, but not by the steady traction of a strong man. Even if we assume that the Mellinger magnet is weaker than the Haab, and my own impression is that my Haab is stronger than my Mellinger, the latter has such outstanding advantages that it is by far the most useful instrument. They may be tabulated as follows:

(1) *The operation can be performed upon a recumbent patient.* This in my opinion is absolutely essential. Removal of a splinter may be one of the most difficult of all operations, one calling for the greatest dexterity. It may also be painful and patients may and have in fact fainted. I have been told of one

tragedy by an eye witness. The patient fainted, fell forward, and ruptured the unwounded eye against the sharp terminal of a Haab. In some cases an anæsthetic is necessary and this can be administered only to a patient lying down. The Volkmann and other magnets are slung and can be used over a recumbent patient.

(2) In the Haab operation the patient must be laid down when the splinter has come forward and a hand magnet employed to extract. In more than one case I have lost sight of the fragment and have had to get him off the table and again present him to the Haab. On one occasion I had to do so three times, because each time the patient moved to the table the fragment fell behind the iris out of sight. With the Mellinger you place the splinter where you want it, and turn off the current. The splinter remains where it is placed and is easily extracted.

(3) There is no necessity to use a hand magnet. These have little power, and are generally driven by dry cells or accumulators which not infrequently fail to supply current on demand.

(4) The power of the magnet is concentrated at the center of the ring where the eye is placed, the lines of force are parallel and do not diverge as they do from the poles of an orthodox magnet.

(5) The operation is performed upon a motionless patient with rods which are convenient to hold in the hand and which admit of the most delicate manipulation. This is a very different proposition to maneuvering a patient's head before a large magnet.

(6) All the operations are performed upon the open eye in an excellent light. With all the other magnets a huge cone of metal is placed before the eye and side vision alone is possible.

(7) The force used is under absolute and perfect command. The size of the rod governs the amount of magnet attraction which can be further modulated by the use of the rheostat. I find that the rheostat is rarely altered, and is hardly necessary. It will be seen that when using the ring magnet we operate under the conditions normal to an eye operator, conditions which admit of the most delicate and accurate procedures. In comparison the Haab operation is clumsy, difficult, and sometimes almost brutal. It is rarely capable of delicacy and the

operator is dependent upon the good behavior and common sense of his patient, qualities which may be conspicuously absent. I am perfectly sure that I have removed pieces of steel from eyes with the minimum of traumatism using the Mellinger when had the Haab alone been at command the eye might have been lost. One example occurs to me. A twist drill broke and part of it entered the eye. It appeared at the wound of entry in the sclera when attracted by the smallest rod, but refused to leave the eye, being caught behind the sclera by part of the twist. After slightly enlarging the wound the fragment was again attracted and gradually twisted and maneuvered free. An operation of this kind would have been impossible with any other magnet. I have no hesitation in saying that no surgeon with an open mind who has experienced the ease with which splinters can be handled in the Mellinger ring will have any wish to revert to other magnets.

LITERATURE.

1. Schirmer, Otto. "Praktische Erfahrungen ueber den Innenpolmagnet." *Zeitschrift für Augenheilkunde*, December, 1908.
2. Butler, T. Harrison. "The Ring Magnet." *British Journal of Ophthalmology*, January, 1907, vol. i., No. 1, page 46.
3. Hertel, E. "Ueber Magnetleistungen." *Klinische Monatsblätter für Augenheilkunde*, May, 1919, vol. lxxii.

Also:

Mellinger. "Report of the Tenth Ophthalmological Congress at Lucerne, 1904." See *The Ophthalmoscope*, December, 1904.

Jurnitschek, Felix. "Praktische Erfahrungen ueber den Innenpolmagnet." *Zeitschrift für Augenheilkunde*, November, 1905. See *The Ophthalmoscope*, August, 1906, p. 466.

Amberg, H. "Weiterer kasuistischer Beitrag zur Entfernung von Eisensplittern aus dem Auge mit den Innenpolmagnet." *Zeitschrift für Augenheilkunde*, December, 1907. See *The Ophthalmoscope*, 1908, p. 382.

Butler, T. Harrison. "The Ring Magnet." *The Ophthalmoscope*, May, 1909, p. 325. This article gives illustrations of the original form of the ring magnet, and others which show the distribution of the lines-of-force in the Haab type and in the *Innenpolmagnet*.

RADIUM AND X-RAY IN TUMORS OF THE HYPOPHYSIS.[1]

By DOUGLAS QUICK, M.B. (Tor.), Assistant Surgeon, Memorial Hospital, New York City.

THE diagnostic signs of tumors of the pituitary gland are now well established and to none are these more familiar than to the ophthalmologist. It will, therefore, be quite unnecessary to consider them in detail except to mention a few outstanding features.

The clinical history together with ophthalmoscopic examination and X-ray findings are usually quite conclusive. The latter is especially valuable where bony destruction is noted, because it definitely suggests a neoplasm.

The relation of hypophysial function to the endocrine system at once introduces a physiological principle about which we have yet imperfect knowledge, but which we must consider seriously in dealing with the various functional disorders that usually complicate the picture. In many cases the functional derangements incident to a pituitary tumor may dominate entirely and be the only evidence of that tumor. On this basis Béclère (1) has divided the tumors into two classes—those which produce symptoms due to compression, and those producing symptoms referable to the bony skeleton. The functional factor is again frequently evidenced in the type of tumors found and in the spontaneous regressions so often seen.

No other organ in the body, so inaccessibly located, furnishes such a variety of tissues in its embryologic origin. For this reason a brief review of the pathology of pituitary tumors is essential to a clear conception of what we may expect from this standpoint. The same knowledge is indispensable when we speculate on the value of radio-activity as a therapeutic agent, since much of our progress must be made by applying here experience gained in other parts of the body on tumors more accessibly located and on which we have a definite microscopic diagnosis.

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[1] Read by invitation before Section on Ophthalmology, New York Academy of Medicine, December 15th, 1919.

In his recent book on neoplastic diseases, Dr. Ewing (2) has divided hypophysial tumors into four groups according to the part of the gland from which they arise.

1. Tumors of the pituitary body.
2. Tumors of the hypophysial duct and its derivatives.
3. Tumors of the pars intermedia.
4. Tumors of the pars nervosa.

The anterior lobe of the hypophysis, or the gland proper, is developed from an upward evagination of oral ectoderm which at once suggests the type of tumors we may expect. The adenocarcinomas are nearly all atypical, tend to rupture the dural envelope, and may extend to a considerable distance. Cases previously termed sarcoma, angiosarcoma, myxosarcoma, perithelioma, and endothelioma are in most instances probably only more atypical forms of adenocarcinoma and should be classed as malignant atypical carcinoma—these represent about one fourth of all cases.

They have all grades of malignancy and while they may metastasize still this is unusual. In addition to these true neoplasms there are a large number of pituitary growths, so called, that are not true tumors but simple hyperplasias. Functional changes are so frequent and so marked as often to simulate neoplasms and probably true tumors develop on this hyperplastic basis. The greatest activity is shown in pregnancy and this increases with succeeding pregnancies, and pressure symptoms, such as hemianopia, may develop from the hyperplasia of gestation. Many of the glandular lesions of acromegaly are not true tumors but simple hyperplasias.

It is quite possible that disturbance of the inter-relation between ductless glands has some bearing on the development of benign pituitary tumors. Cushing (3) has shown that the natural history of many hypophysial diseases is associated first with overactivity and acromegaly and later a period of underactivity and adiposogenital dystrophy. Epithelial tumors of the anterior lobe associated with acromegaly are the most common, but that on the whole these are relatively benign is shown by the usual slow clinical course.

In the remnants of the hypophysial duct there is represented tissue originating from oral ectoderm as well as from true dermal cells from the invagination of cranial epidermis carried into the brain vesicles in embryological development. Most of the true tumors found here are of squamous or basal epithelial type from oral epithelium, together with certain mixed tumors of the salivary gland type and dermoids, many of which are cystic.

The pars intermedia is the lingual process of the anterior lobe which ensheathes the zone of nervous tissue about the infundibulum or prolongation of the third ventricle. The epithelial cells of this portion show some evidence of a secretory function and while tumors arising in this location are extremely rare, still their peculiar structure suggests some relation to the unusual activities of this bit of epithelium.

The posterior lobe is composed entirely of nervous tissue and tumors originating here are rare. They may be gliomas, or lipomas from fat tissue about the remains of Rathke's ectodermal pouch in the connective tissue septum between the anterior and posterior lobes.

This knowledge of pituitary tumors together with a recollection that the gland is located in a bony cup in an extremely dangerous and inaccessible part, from a surgical standpoint, at once suggests several factors in the treatment of these tumors.

Until recently surgery of the hypophysis has been conspicuous by its high operative mortality and even now it is relatively safe only in the hands of a few very expert and experienced specialists. The operative procedures reported to date have been, mainly, of two types. In many cases where pressure is marked and radical removal contra-indicated a palliative operation, usually a decompression, has been done with temporary relief in many instances, but this is a wholly inadequate procedure and makes no pretense at reaching the seat of disease. The radical operations for removal of the gland, although costly in the past, are improving and if the tumor be a benign hyperplasia a relief of pressure symptoms may be obtained for an indefinite period. The location of the operative field is such that a clean cut dissection is rendered difficult and a total removal often impossible, while a wide removal such as we are usually able to make in many other locations is out of the question. Our observations on cutting into a relatively benign growth have shown that in many instances it is the signal for a rapid increase in the rate of growth, while the partial removal of a malignant tumor is worse than useless. A review of the literature on surgery of the hypophysis emphasizes two points,—the wide variation in operative mortality, which of course is to be expected, and the relatively small group of cases in which surgery offers anything worth while.

In outlining the prognosis in radical pituitary operations Kanavel (4) places the operative mortality in the neighborhood of 35 per cent. in the hands of those doing little cranial surgery, but he makes special note of the work of Hirsch and Cushing where the rate is down near to 10 per cent. In his own series of fifteen cases there were four deaths. He states that in all cases the visual symptoms are improved excepting where optic atrophy is complete: the excessive adiposity is benefited if feedings of the whole gland are used in conjunction with operation, but skeletal changes are little influenced. In his special mention of good results he cites five cases of cysts operated upon by Hirsch with relief of symptoms in all and an adenoma removed by Halstead and well three years later.

Cushing (3) has reported forty-three cases on whom a total of sixty-one operations have been done with an operative mortality of 10 per cent. for the series. His very complete tabulations indicate a great improvement in technique toward the end of the series and undoubtedly his more recent work shows a much lower mortality than that just indicated.

Hirsch (5) divides the cases into three groups: (1) solid, predominantly intrasellar tumors; (2) solid, predominantly intracranial tumors, and (3) cysts, which cannot be diagnosticated until the operation. If the patient presents eye symptoms the tumor must be intracranial, and here he states that a radical removal is impossible—and we know that in dealing especially with tumors presenting any degree of malignancy the partial removal is a detriment rather than a benefit. He places his operative mortality at 13 per cent. and notes that Cushing has had practically the same rate. Of thirty-seven cases twenty-one had marked and permanent improvement up to three years, in part with restoration of working capacity. It is to be inferred from his report that these were all cysts or benign tumors.

The report of Moritz (6) agrees with the other surgical results in that the relief of visual disturbances and headache are the most marked, while metabolic and trophic changes may be altered but slightly or not at all.

Even with the advances made in pituitary surgery in the past few years, it does not represent, by a wide margin, the ideal treatment for tumors in this location and consequently many other methods have been tried.

During the past few years X-ray and radium have been used more and more in attempts to influence pituitary tumors, both as an aid to the operative procedure and in recurrences, as well as in many primary tumors. The results of this work to date are very incomplete and contradictory but a brief review of some of the more recent literature may be of value in suggesting improvements.

Six years ago Béclère (1) reported four cases treated with X-ray and observed from one to five years. The most marked improvement was in complete disappearance of headaches, dizziness, nausea, and vomiting. Along with this there was a cessation of the pathological process and a gradual increase in the visual fields as well as a partial or complete restoration of sexual function. In one of his cases where there was an actual degeneration in the optic nerves there was no improvement in the vision but he was inclined to suggest that in the absence of degeneration a slow improvement in vision could be hoped for. He also states that the Roentgen ray is chiefly applicable to those tumors producing pressure, but that in the ones causing skeletal changes only it will not influence the symptoms once they are established although it will check the abnormal pituitary growth and render the associated symptoms stationary.

Loeb (7) has reported a case presenting symptoms of headache, dizziness, nausea, and failing vision which responded rapidly to X-ray treatment but he noted especially that while the headache, dizziness and nausea, cleared up promptly the visual field increased only slowly. The case had been followed only a few months but the report is of interest because of the described technique. The equipment used was a coil and interrupter with a water-cooled tube and very small amount of filter and exposures were given on the fractional plan frequently until an erythema was reached. I believe that I am correct in stating that this type of equipment has now been very much improved upon. The portals of entry were through both temporal regions and through the nose.

In an article dealing primarily with pituitary surgery Küpperle (8) cites a case of malignant tumor where symptoms recurred several months after a palliative decompression and where loss of vision was complete. Here X-ray in massive doses and heavily filtered, was applied externally and Mesothorium was applied through the mouth—a combination of radiation. Treatment was kept up vigorously for eight weeks at the end of which improvement became apparent and at the time of his publication seven months later the patient was still enjoying a fair amount of vision. He advised this technique after all operative measures and as the sole treatment in many cases. Cushing (3) also advises the use of X-ray after operation in cases where only a partial removal has been done.

Gunsett (9) reports a case with visual symptoms and acromegaly where improvement of vision began a few weeks after X-ray treatment started and three months later was continuing favorably. He points out that this improvement was associated with no untoward symptom either constitutional or local over the scalp. While vision was much benefited the acromegalic symptoms remained practically unchanged. He suggested that at some future time radium might quite probably replace X-ray because of the possibility of applying it internally.

A most interesting case is reported by Cauvin (10), one exhibiting marked visual pressure symptoms with acromegaly and adiposogenital dystrophy where the vision had been almost zero for eighteen months. After the first treatment headaches improved remarkably and except for attacks at rare intervals, lasting only a few minutes, disappeared. The case was followed three years up to time reported and vision had become nearly normal. There was some improvement in fat deposits but none of course in the skeletal changes.

A rapidly progressive case in a girl of sixteen years presenting all symptoms of pituitary tumor,—attacks of headache, vertigo, nausea, vomiting, enlargement of sella turcica, gigantism, genital infantilism with deposits of fat, and marked visual disturbances,—is recorded by Béclère, Renon, Dehille, and Monier-Vinard (11). The temporo-frontal region of the skull was divided into five areas on each side and a massive dose of X-ray given through each area successively at intervals of a week. After two weeks there was evidence of improvement and at a month this was well marked. The headaches, vertigo, nausea, and vomiting disappeared. Vision improved until there was excentric increase of visual fields 3½ times as extensive as before treatment. Growth of body framework was arrested both in thickness and length. Genital functions were reëstablished—menstruation, breast development, and appearance of pubic hair. Fatty deposits and body weight diminished. The length of treatment or observation period is not stated.

The observations of other workers, notably Calamet (12), Williams (13), Gramegra (14), Terrien (15), and De Lapersonne and Cantonnet (16) also confirm the findings of those already mentioned. The pressure symptoms are benefited in most instances, the relief from headaches, vertigo, nausea, and vomiting being first with a gradual relief of visual disturbances except when optic atrophy with degeneration has already occurred. The metabolic and trophic disturbances may be appreciably benefited but in many cases they are not: however, the arrest of progressive symptoms belonging to this class is noteworthy.

Our observations on hypophysial tumors at the Memorial Hospital have been limited to three cases, a fourth having disappeared very soon after treatment was begun so that no observations of value were made. Our treatment has been confined to radium rather than a combination of X-ray and radium—possibly a mistake in view of the results reported by the X-ray workers.

The first case, a woman 31 years of age, came to us eighteen months ago with total loss of vision in the right eye and light-perception only in the left, headaches moderate and slight vertigo, complete loss of olfactory sense, acromegalic symptoms well established but not marked. She had had a removal of an adenoma a year before and a second operation for recurrence a month previous to admission. Both operations were done by the intranasal route. X-ray examination showed marked sellar enlargement but no bony destruction other than that incident to the operative procedure. Access to the lower portion of the tumor was readily gained by shrinking the nasal mucosa with adrenalin and on July 17, 1918, five fine glass capillary tubes of radium emanation, unfiltered, and total strength of 15 millicuries, were embedded through trocar needles in the lower portion of the tumor and left there. Following this treatment the headache and vertigo disappeared entirely and vision improved in both eyes, more in the left, so that the patient could go about the city unattended. We attribute this improvement to the radiation, but recognize the possibility of some benefit from the recent surgical procedure. March 27, 1919, one tube of emanation, total 30*mc*, filtered by 0.2*mm* of aluminum and enclosed in a small rubber tube was inserted into the space where floor of sella was removed and left for one hour and thirty minutes. On April 30, 1919, two fine capillary tubes of emanation, total 3.2*mc*, were embedded through trocar needles in the same manner as the first treatment. The vision has improved to date sufficiently to permit the patient attending to some household duties and going about unattended. She has no headache, vertigo, nausea, or vomiting. The acromegalic symptoms have remained unaltered.

The second case, a woman of 37 years, has been under our care for fifteen months. Seven years previously she began having attacks of vertigo during pregnancy; headache became severe and persistent; a short time later vision became impaired and this was followed by a cessation of menstrual function three years after first symptoms appeared. Since menstruation ceased there has been persistent lactation. At the time of admission to our service, headaches and vertigo were very distressing: vision was sufficient to read the largest headlines of the newspaper only. Gigantism and fat deposits were extreme and her sugar tolerance was very much increased. She had had no operative treatment.

On October 24, 1918, under local anæsthesia, a submucous resection of the nasal septum back to the sphenoid was done. The sphenoidal sinuses were opened but the floor of the sella was not removed. A 0.2*mm* aluminum tube containing 40*mc* of radium emanation, encased in rubber, was then introduced into the sinus, placed against the floor of the sella and retained in position by gauze packing for twelve hours. Following this treatment there was definite relief of pressure symptoms, but, later, headaches again became more severe although vision continued to improve and vertigo had disappeared. On June 30, 1919, 605*mc* of radium emanation filtered by 2*mm* of lead and 0.5*mm* of silver was placed over the right temporal region at a distance of 4*cm* from the skin and left in place for five hours and the following day the same dosage was repeated over the left temporal region. After this treatment there was a lessening of headache but at no time has it disappeared. Vision has improved quite appreciably. The acromegalic symptoms have remained stationary and fat deposits are practically unchanged. Lactation has ceased.

The third case, a man between 30 and 40 years of age, had had a second operation for recurrent tumor, through the nasal route, just before coming to us. He showed marked pressure symptoms with almost complete loss of vision. Radium emanation was buried in the tumor in the manner mentioned before, but the patient died about a month following treatment, from meningitis. When he came to us he had infection in the upper nasal passages and ethmoid cells. Moritz (6) has noted that in every case dying from meningitis following operation they were reported to have been suffering from coryza and nasal discharge at the time or shortly previous to the operation—the lesson is obvious.

I have been unable to collect from the literature other cases treated with radium.

In comparing the surgical and radio-therapeutic results it is quite evident that pressure symptoms are most favorably influenced while metabolic and trophic changes are little affected, with either method. However, three factors stand out in favor of treatment by X-ray or radium: (1) There is no operative mortality. (2) Pressure symptoms—visual changes, headache, vertigo, nausea, and vomiting—respond much more promptly and with greater uniformity to radiation than to surgery and this is accomplished without pain or inconvenience to the patient in any way. (3) Radiation offers a hope to every case of pituitary tumor, except possibly the simple cysts, whereas surgery is confined to a small group of hyperplasias and benign tumors. Since it is admitted by Hirsch that the removal of intracranial tumors is very apt to be incomplete and since only this type produce pressure symptoms it is very questionable if radical surgery is indicated here, in view of the benefits conferred by radiation. Certainly the partial removal of a malignant pituitary tumor is not to be countenanced when physical agents are available and in two of our own cases the recurrence within a year of tumors primarily benign or of slow growth suggests an acceleration of growth by the operative trauma.

The metabolic and trophic disturbances are little affected by any means as far as improvement is concerned but it is shown that these changes may be rendered more or less stationary and here again radiation offers a wider range of application with no danger or inconvenience to the patient. Indeed, it is quite conceivable that, in certain types of hypophysial disease, the removal of a portion of functionating tissue in the attempt to get out a tumor may aggravate the constitutional changes.

For many reasons pituitary tumors offer a favorable field for radiotherapy. Many of the so-called tumors are hyperplasias and not neoplasms. A large number of these are small and of slow growth and of the true neoplasms the carcinomas and adenocarcinomas which predominate are nearly all of a structure which is relatively susceptible to physical agents. Metastases from hypophysial tumors are relatively rare. Since these theoretical considerations are now fortified by considerable practical experience in the use of X-ray, and in a lesser degree of radium, our problem at the present time lies in the technique of application.

The Roentgen ray has this in its favor, that the pituitary is located practically at the center of a spherical segment which permits of radiation through several portals of entry from one temporal region directly around over the frontal region to the opposite temporal point as well as through the region of the nose. This permits of the concentration of radiation at the pituitary body. It also has the advantage from the point of universal application that many hospitals are now equipped with standard Roentgen apparatus so that treatment may readily be given.

However, there are certain disadvantages in the use of X-ray. The pituitary is completely enclosed in a bony box on all sides and from some portals of entry there are interposed crests of bone to add to the filtration and scattering already produced by the cranial vault. It is also now well established by our experience in treating neoplasms in other parts of the body with radiation that the difference between success and failure rests with the nicety of, and to a certain extent with the intimacy of, the application. Another factor which must be considered seriously in using X-ray over such a wide area externally is the possibility of permanent damage to the retina. In radium we have an agent much more powerful than X-ray, and since it lends itself readily to internal application in a very limited space it overcomes the objection to the use of external radiation over an extensive surface for a prolonged period.

The shock of a radical operation in the hypophysial fossa together with the inefficiency and probable injury from incomplete removal renders this type of operation a very serious consideration. On the other hand, a conservative operative procedure, carrying no appreciable risk and performed under local anæsthesia without cutting into the tumor, is, in my opinion, both justifiable and desirable when it renders the radium application more accurate. I refer to an operation similar to that mentioned in our second case. In this case a submucous resection of the posterior portion of the nasal septum back to the sphenoid was done and then with a specially constructed type of self-retaining bivalve speculum or retractor, the shell of bone over the sphenoidal sinuses was readily exposed and the sinuses opened. The radium was then applied to the floor of the sella. This was done very comfortably under local anæsthesia and with the patient in the sitting position. We now believe that it would have been a distinct advantage to have gone one step further and removed a window from the floor of the sella, thus exposing the gland directly. This would have permitted a more direct surface application of radium as well as the introduction of buried emanation through a trocar needle, as in our other case.

In my opinion this method of application of radium in hypophysial tumors offers the best chance for an accurate approximation of a well selected dosage with a minimum risk to the patient.

While our personal experience has been limited to these few cases, still I believe the observations made warrant us in looking forward to future work in this line with considerable optimism.

BIBLIOGRAPHY.

1. Béclère. "Die Roentgenbehandlung der Hypophsengeschwülste, des Gigantismus und der Akromegalie." *Strahlentherapie*, Bd. iii., 1913, p. 508. "Les Rayons de Roentgen dans la Traitement des Tumeurs Hypophysaires du Gigantisme et de l'Acromégalie." *Journal de Radial et d'Eléctral*, 1914, vol. i., No. 3, p. 138.
2. Ewing, James. *Neoplastic Diseases.* Philadelphia, W. B. Saunders Company, 1919, p. 906.
3. Cushing, Harvey. *The Pituitary Body and its Disorders.* Philadelphia, J. B. Lippincott Company, 1912.
4. Kanavel, A. B. "Surgery of the Hypophysis." *Oxford Surgery*, 1919, vol. iii., Chapter VIII., p. 438.
5. Hirsch. "Traitement Opératoire des Tumeurs de l'Hypophyse." *Archiv. Internat. de Laryngol. d'Otol. et de Rhinol.*, 1914, vol. xxxvii., No. 1, p. 20.
6. Moritz, M. "A Review of Some of the More Important Factors Involved in Operations on the Hypophysis Cerebri." *British Journal of Surgery*, 1913, vol. i., No. 2, p. 193.
7. Loeb, Clarence. "Deep Roentgen-Ray Therapy in the Treatment of Tumors of the Hypophysis." *Transactions of the American Academy of Ophthalmology and Oto-Laryngology*, 1917–18, p. 58.
8. Kupperle, V. Szily. "Ueber Strahlentherapie bin Hypophysen Tumorsen." *Dtsch. Med. Wchschrft.*, 1915, No. 31, p. 910.
9. Gunsett, A. "Ein mit Roentgenstrahlen behandelter Fall von Akromegalie." *Strahlen-Therapie*, 1914–15, vol. v., p. 70.
10. Cauvin, C. "Acromégalie, Tumeurs de l'Hypophyse, Troubles Ventaires. Traitement Organo- et Radio-Thérapeutique." Guérison. *Archives d'Ophtalmologie*, 1912, xxxii., p. 657.
11. Béclère, Renon, Dehille, Monier-Vinard. "Gigantisme avec Tumeurs de l'Hypophyse." *Soc. Méd. des Hôpitaux*, 4 December, 1908.
12. Calamet, C. F. "Sur un Cas de Hemianopsie Bi-Temporale pas Tumeur de l'Hypophyse." *Archives d'Ophtalmologie*, 1916–17, vol. xxxv., p. 103.
13. Williams, T. A. "Case of Subsidence through Radio-Therapy of a Neoplasm in the Region of the Hypophysis Cerebri." *Washington Medical Annals*, 1916, vol. xv., p. 103.
14. Gramegra, A. "Un Cas d'Acromégalie Traite par la Radiothérapie." *Review Nécrologique*, 1909, vol. xvii., p. 15.
15. Terrien, F. "Le Traitement par les Rayons des Troubles Visuels d'origine Hypophysaire." *Archives d'Ophtalmologie*, 1916–17, vol. xxxv., p. 257.
16. De Lapersonne, F., Cantonnet, A. "Troubles Visuels Produits par les Tumeurs de l'Hypophyse sans Acromégalie." *Archives d'Ophtalmologie*, 1910, vol. xxx., p. 65.

NON-SURGICAL TREATMENT OF PITUITARY DISORDERS.[1]

By WALTER TIMME, M.D., Neurological Institute, New York.

POSSIBLY the best classification of pituitary disorders into groups for purposes of therapy is that based upon a primary division depending upon characteristics of the sella turcica, with secondary qualifications, in each division, based upon the symptomatology. Objections to such a scheme, of course, easily obtrude themselves, but in my experience, I have found it the most efficient. The basic reason for such classification is the evidence, more or less accurate, that is furnished frequently by sellar changes in the course of a pituitary disorder determining the self-limitation, either complete or partial, of the process. Upon the extent of the success of such limitations, therapy may be unnecessary or it may be radical. Between these extremes, all gradations are to be considered.

Such a classification is here appended, but it does not presume to be either complete or final, but is simply an attempt to clarify the present situation. Especially under the symptomatology only the salient features are indicated,—sufficient for the recognition of the various types amenable to therapy.

	Character of Sella Turcica.	*Salient Features of Symptomatology.*
Group "A"	With no demonstrable physical enlargement or diminution. Seemingly normal sella.	*Underactivity.*—Usually undersized; maxillary prognathism; crowded teeth; adiposity; Froelich's dystrophy; low blood pressure; menstrual disturbances; diminished libido; diabetes insipidus.

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[1] Read by invitation before Section on Ophthalmology, New York Academy of Medicine, December 15, 1919.

	Character of Sella Turcica.	*Salient Features of Symptomatology.*
GROUP "A"—Cont'd		Somnolence; mentally dull and apathetic; lack of concentration. High sugar tolerance. *Overactivity.*—Frequent and severe headaches; rapid growth; moderate contraction of visual fields; sexual trends; high blood pressure. Great mental activity; initiative; irritability. Low sugar tolerance.
GROUP "B"	With demonstrable smallness of sella turcica and lack of cavity space for proper expansion of the gland.	Signs of congenital hypopituitarism; may or may not be headaches; Froelich's dystrophia adiposogenitalis; lack of proportionate skeletal build; fatigability; adiposity; usually small genitalia and perhaps reversion in type; sex abnormalities. *Mental Signs.*—Compulsions; lack of inhibition; pathological liars; intellectual and moral inferiority; little initiative; epilepsy. High sugar tolerance. Frequent relative lymphocytosis.
GROUP "C"	Demonstrable original smallness of sella turcica with erosions, enlarging the cavity in any or all directions.	Pressure Signs.—Long-continued and periodic headaches, occasionally migrainous with ophthalmoplegia—third nerve, fourth nerve, sixth nerve; unilateral temporal headache with lacrimation (nerve from ophthalmic division of fifth); epilepsy, with later uncinate fits. Metabolic Signs.—Fatigability with headache and irregular menses and suprarenal deficiency. Secondary frequently to status thymico-lymphaticus. Disturbances in growth; acromegaly; spacing of teeth; prognathism.

	Character of Sella Turcica.	*Salient Features of Symptomatology.*
GROUP "C"—Cont'd		Mental.—Slow development; gradual self-adjustment; and cure.
		If Erosion Anterior.—Bitemporal hemianopia.
		If Erosion Posterior.—Pyramidal tract lesions.
		If Erosion Lateral.—Oculomotor disturbances; migraine.
GROUP "D"	Demonstrable enlargement in all cavity dimensions.	Pressure Signs.—Headaches; bitemporal hemianopsia; oculomotor palsies; epilepsy; intracranial pressure; papillœdema.
		Metabolic Signs.—Acromegaly; giantism; disturbed sugar tolerance; etc.

THERAPY.

GROUP A. *Underactivity.*—If this underactivity be presumably of the anterior lobe, giving rise to low temperatures, deficient genital development, Froelich's dystrophy with attendant physical and mental characteristics, then feeding of the whole gland in doses of from one half grain as infrequently as once or twice a week up to one or even two grains three times daily may be administered, depending upon the reaction of the patient to the dose, especially as regards the production of headache, excitability, insomnia, nausea, and vomiting, and rapid fatigability. But in addition thereto, either feeding of the anterior lobe, or hypodermatic injections of the *anterior lobe extract*, will often be found of value, especially in the Froelich syndrome with genital lack of development and in low bodily temperatures. Very small doses of thyroid gland, gr. $\frac{1}{100}$ to gr. $\frac{1}{10}$, every day or on alternate days, will frequently enhance the effect of the pituitary administration. If the disturbance symptomatically may be referred to the posterior lobe, then whole gland feeding as above mentioned may be carried out in the same way, but as an adjuvant; occasional hypodermatic injections of the posterior lobe extract (pituitrin, etc.) in doses varying from 0.3*cc* to 1*cc* may be added thereto. But if these injections are given once or twice daily in full amounts, they must not be continued for over a week at a time. Intense asthenia may otherwise be produced. Especially in uncompensated cardiac conditions is this measure to be very carefully administered, if at all. In critical cases, with extremely low blood pressures, great fatigability, and conditions of shock, besides whole gland feeling, if that is possible, rapidity and greater certainty of action are produced not only by hypodermatic injections of pituitrin, but also by rectal injection of saline dilution of pituitrin and intravenous saline dilution as well. In cases of diabetes insipidus, both hypodermatic and intravenous injections of pituitrin are of service in diminishing considerably the output of urine. If the fatigability is very great, occasional additions of whole gland suprarenal extract (not adrenalin) are effective.

Overactivity.—The therapy in this condition varies, dependent upon the cause for the overactivity. If this cannot be found and eliminated, then it is wise to give sedatives such as luminal, which is very effective in doses of one half grain once or twice a day for a few days at a time. Pilocarpine in one-tenth-grain doses or acetanilid in two-grain doses several times daily are alternates to the use of luminal. Frequently, however, disturbances in the genital sphere, the climacteric, will produce secondary pituitary activity. In these cases administration of lutein or ovarian extract will be found of benefit. When the activity is secondary to a thyroidectomy—as is occasionally seen—then small doses of thyroid gland will relieve the symptoms. In too early thymic involution, with pituitary overactivity, thymus gland in one- to five-grain doses several times daily is often effective. Occasionally an inefficient chromaffin system will give rise to overactivity on the part of the pituitary, which may be offset by feeding whole gland suprarenal extract.

It may not be amiss at this point to give my experience with the so-called antagonistic therapy as applied to hyperhypophysism. That is to say, the administration of pituitary gland in cases of pituitary hyperactivity. The rationale of such procedure is of course that immediately available pituitary extract will tend to diminish the requirements made upon the pituitary body and so produce a gradual diminution of its activity. If such procedure is undertaken, I have at first found an increase of the symptoms complained of, sometimes the headache becoming unbearable, but if the administration is then stopped for a few days, a condition of relief from all the original symptoms supervenes. My plan in such cases is, therefore, to give fairly large doses—one grain three times daily of the whole gland for two or three days at a time with a succeeding interval of rest. I have had a fair measure of success with this method.

Group B. This group represents in the adult the various uncompensated hypopituitary conditions. In children, there is still the hope for a gradual enlargement of the sella turcica present, and hence whatever now may be said, refers to the adult cases. In children and adolescents it would be wise to have occasional radiographs (one or two a year) made of the sella turcica to determine possible enlargements. In adults then, these cases require feeding of the whole gland for an indefinite time, much as thyroid feeding is required in myxœdema. The dosage is to be regulated between the extremes of tolerance and the relief of symptoms. It will be found that as the patients become familiar with changes in their condition, they will gradually begin to regulate the dosage themselves, usually at the lowest point sufficient to overcome their difficulties. Again, the same suggestions are here pertinent that were advanced under the "underactivity of the pituitary" in Group A. It is to be remembered, however, that thyroid feeding in this group (B) is usually contraindicated for the reason that its administration gives rise to severe pituitary headaches. However, suprarenal gland, in cases complaining of great fatigability, is usually a valuable adjuvant. The dose should be about a half-grain three times a day, gradually modifying it to meet requirements. It should not be continued over a week or ten days at a time.

Group C.—In this group we find the signs and symptoms that are of so much importance in ophthalmology. Bitemporal hemianopsia, oculomotor palsies with occasional swelling of the disks are the more important manifestations. It is also, however, in this group that we meet with the compensatory enlargements of the hypophysis that finally are the determining factor in the automatic readjustment of the disturbed processes in the internal glandular mechanism. For this reason, it is well to administer glandular products with caution, and always in small dosage. The determining factor for therapy is the intense headache, usually of migrainous character, with perhaps temporary oculomotor palsies or choked disk. Epilepsy is a not infrequent symptom. A good plan is to begin with putuitary feeding of whole gland in about one tenth to one quarter grain doses daily or on alternate days and gradually increase if necessary. It is my practice to omit the administration for one or two days a week in any event. If there is no response to this, the dosage is pushed up to tolerance and kept there for a few days. Usually, providing the erosion of the sellar walls is not due to neoplastic involvement, we get pronounced relief and the condition goes on to actual cure.

Occasionally,—in my personal experience three times,—symptoms which were those of either cyst or tumor of the hypophysis, including headache, vomiting, bitemporal hemianopsia, choked disk, and in one case double ankle clonus, and a positive Babinski, disappeared completely and two of the patients are now alive and well after several years, with absolutely no signs of their disturbance remaining. The therapy consisted in combinations of feeding and hypodermatic injections of pituitrin as its basis. Frequently the cases in this group develop their hypophysial hyperplasia as a compensation for a deficient adrenal system. In these cases, it is unwise to administer thyroid even in small doses, for their blood pressures drop, a white Sergent line is evoked, acidosis develops, and symptoms of collapse come on. If this is surmised, thyroid may be administered in small doses, grain one tenth every other day, combined with suprarenal gland. It is supererogatory to state that the frank tumor cases, if not rapidly responding to treatment, need operative interference, or radium therapy.

Group D.—By the time the sella turcica has reached the universally enlarged stage, with perhaps no clinoids left, or with the erosion developed to the point of canalization into the sphenoid sinus, the physical signs and symptoms will have proceeded to the point at which either, in a compensatory manner, due to simple hyperplasia, the adjustment is complete and no further therapy is indicated, or else the enlargement was produced by a new growth and the symptoms have arrived at the stage where short of surgical intervention or perhaps radium therapy, nothing else is of avail. The symptomatology due to such cause at this time will be of any and every variety of disturbed pituitary function, deficiency symptoms of one lobe combined with hyperactive ones of the other and perhaps all dominated by the mechanical signs and symptoms of intracranial pressure. The reason for such combination is not far to seek and need not be entered upon here. Therapy is of practically no avail. Nevertheless, even the best of cranial surgeons have declared that even at this stage all possible therapeutic measures and glandular administrations should be invoked before surgical intervention is attempted.

In placing before you such a schematic representation of therapeutic measures, please let it be understood that it is schematic and that it is only to serve in a general way for guidance. No patient or disease can properly be treated according to tables of drugs and dosage any more than that two human beings are constructed alike or think alike. Individualism is the keynote.

THE CAPSULE IN CATARACT EXTRACTION.[1]

BY EDWARD JACKSON, M.D., DENVER, COLORADO.

WHAT should be done with the lens capsule in cataract extraction has been of recent years the most discussed point of operative method and technique among ophthalmic surgeons. But such discussions have ignored the fundamental anatomy, physiology, and pathologic possibilities of the structure under discussion. A brief review of the forgotten essential factors in the problem will help to get clear of a certain traditional attitude toward the capsule of the crystalline lens, that has caused it to receive the blame for undesirable results due entirely to other tissues, and which a rational disposition of the capsule would do much to prevent.

The capsule is an elastic transparent membrane, not staining by elastic tissue stains; but having a chemic composition most nearly similar to that of sarcolemma (Chittenden) (1). In the words of Collins and Mayou (2), "The hyaline capsule itself does not become opaque." Its refractive index is generally assumed to be about that of the crystalline lens; but so far as I know it has not been carefully measured. Landolt (3) does not mention it, and Tscherning (4) makes no reference to it, although in discussing what he calls "supplementary astigmatism" the difference between ophthalmometric and subjective astigmatism, he says it may be "attributed to many other causes" than astigmatism of the lens.

If the capsule has the same index as the lens, the differences in its thickness in various portions are of no importance in regard to refraction, so long as its external surface has a regular lens curve. But these variations in thickness may be of real importance when the lens has been removed, and the capsule remains in a medium having the index of the aqueous or vitreous. Salzman (5) gives the thickness of the lens capsule measured at five different points, in 17 eyes of persons ranging from 14 days to 71 years in age. The averages of these are shown in this table, expressed in microns:

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[1] Read at Colorado Congress of Ophthalmology and Oto-Laryngology Denver, August 4, 1919.

AGE.	NO.	A. P.	A. M.	EQUATOR	P. M.	P. P.
0–15	5	7.8	12.4	8.2	19.	2.7
19–48	9	11.2	19.9	15.8	22.1	3.1
33–71	3	15.3	23.	13.	16.	2.8

From these measurements it appears that the capsule is thinnest at the posterior pole (P. P.), and thickest at a point (P. M.) of maximum thickness of the posterior capsule, a zone toward the periphery. Beyond this zone it grows thinner to the equator, after which it again increases to a zone (A. M.) of maximum thickness for the anterior capsule, also quite peripheral, and then thins toward the anterior pole (A. P.).

The changes with age are not great, but the anterior capsule seems to increase in thickness throughout life. At the equator and posteriorly the capsule seems to increase in thickness to about middle age, and then diminishes in old age. But the posterior capsule is almost as thick in childhood as throughout later life.

The anterior and posterior zones of maximum thickness of capsule are about equally (3*mm*) distant from the axis of the lens, so that when left in the eye after extraction of the lens the refractive influence of one is added to that of the other. This would amount to that of a concave lens about 15 μ thick at the center and 40 μ thick at the periphery, 3*mm* or more from the center. Supposing this to have the index of refraction of the lens, and to be surrounded by aqueous and vitreous, such a lens would have a refractive power of one eighth to less than one quarter diopter, a refractive error of no practical importance in a case of aphakia.

But if instead of such gradual variation in the thickness of the capsule as is found normally it becomes thickened in small areas, forming hyaline nodules like those found on other hyaline membranes, such nodules are capable of acting like other irregularities of a dioptric surface, producing dispersion of light comparable to that of ground glass. Such thickenings have been observed on the inner surface of the anterior capsule by Becker (6) most frequently in hypermature cataract. It must, of course, be borne in mind that the capsule of the crystalline lens has in itself no power of proliferation or increase, being entirely dependent for such changes upon the capsule epithelium.

The capsule itself is wholly passive. It does not become opaque, it does not of itself thicken. Whatever changes may occur in the capsule must be regarded as due to activities of the epithelium, closely adherent to the capsule, or to other tissues that have become accidentally associated with it. The disposition of the capsule in extraction of senile cataract takes importance, practically entirely, from the adherent epithelium and the influence of such disposition on other parts of the eye.

In the normal eye, proliferation of the capsular epithelium occurs only in the equatorial region where the cells are developing into new lens fibers. The posterior capsule has given up its cellular lining to develop the first lens fibers. The epithelium of the anterior capsule shows pathologic activity in two conditions that have been studied with some detail, the development of the hyaline nodules above referred to and the development of capsular cataract. The conditions producing the former are not known, but those attending the development of capsular cataract are better understood.

Three influences have been suggested as arousing the anterior capsular epithelium to active growth and proliferation. 1. Disturbance of osmosis by contact of the lens with the cornea (Hulke) (7). 2. The reduction of intracapsular tension by perforation of the capsule or degenerative changes in the lens itself (Collins) (8). 3. Bacterial toxins reaching the epithelial cells, in ocular infections, particularly of the cornea and iris. It is the second of these that seems of most importance in connection with the extraction of senile cataract. If freedom from intracapsular pressure is sufficient to stimulate the epithelial cells to activity, the opening of the capsule by any method should set up cell growth and proliferation.

But here comes in the change in cell activities and potentialities wrought by age. The cells lining the anterior lens capsule have lost their power of normal proliferation, largely before adult life has been reached; and have entered upon a long passive stage, in which their function seems to be rather secretory, controlling the nutrition of the lens fibers. Even their pathologic responses to irritation, shown in anterior capsular cataract, are manifested chiefly in early life. Iritis, furnishing toxins and synechiæ, only exceptionally produces capsular opacities at middle life and later. In senile eyes the epithelial cells become more shallow and less cubular, are evidently less able to sustain their own nutrition (Parsons) (9). In glaucoma and cataract they are found distinctly, even completely atrophied. From all we know about them, the presumption is that when senile cataract has approached maturity the capsular epithelial cells are practically incapable of any considerable proliferation.

As a matter of fact, the membranes that develop in the pupil after cataract extraction, while they may incidentally contain lens capsule and its epithelium, have for their most important constituent, connective tissue, developed from fibroblasts; furnished chiefly by the iris (Parsons) (10), or possibly through the vitreous, but certainly not by the lens capsule or its epithelium. The capsule left in the eye may give these fibroblasts a place to develop, but it certainly does not furnish them. Their presence and quantity depend chiefly on inflammatory reaction provoked in the iris.

The tendency of eyes inflamed after cataract extractions to form membranes, and the relation of the density and opacity of these membranes to the extent and persistence of the inflammation, has been noticed by all who have had much clinical experience. Other things being equal that disposal of the capsule is best which is least likely to be followed by uveal inflammation.

The source of irritation peculiar to eyes after cataract operation is the contact of lens substance with the iris. All of us have seen an eye, quiet after discission of a soft cataract, suddenly become painful, and develop circumcorneal redness, whenever a piece of lens substance has fallen into the anterior chamber. Lens substance left in the anterior chamber after extraction of cataract is certain to add to the severity of the subsequent inflammatory reaction. But nothing of the kind occurs when lens cortex is retained within the capsule.

The most striking thing about extraction of the lens in the capsule is the absence of iritis following immediately after the operation. In spite of the longer incision, and the greater force used to dislocate and expel the lens, iritis is much more rare than after the ordinary capsulotomy operation. Very much the same immunity from iritis has been observed after careful washing out of remaining lens fragments by irrigation of the anterior chamber. Lippincott (11) reported 100 cases with iritis in six, and only 11 in which division of a pupillary membrane was required to secure the best vision.

My own method of disposing of the capsule has been to leave it in the eye as nearly intact as possible, by letting the lens escape through a peripheral linear incision in the capsule. This somewhat resembles the method that Herman Knapp (12) suggested in 1887, and continued to use to the end of his operative career. His method was: "The operator gives the knife back to the assistant and takes from him a cystotome, which he introduces into the anterior chamber, with the knee forward, from the temporal side, near the conjunctival flap, which latter he is careful not to drag into the eye; he then advances the instrument so that the tip goes underneath the upper part of the iris, turns it, and with the tooth makes the incision into the upper part of the capsule parallel with the corneal section about six or seven millimeters in extent. As soon as the capsule is opened the lens makes a visible forward motion. Then the cystotome is withdrawn again with the knee forward, so that the point does not injure the iris."

In July, 1890, I began to make a similar linear capsulotomy (14), but using the point of the cataract knife instead of a cystotome or knife needle, and placing the incision near the edge of the pupil (15). "After completion of the corneal section, and the iridectomy if that is to be done, and after a brief rest, the conjunctival flap is laid back on the cornea; and the cataract knife, sterilized by dipping in water at the boiling point, is brought with the middle of its back to the middle of the corneal incision and pushed into the eye to the position it occupied immediately after the counter puncture. It is then drawn in the direction opposite to that in which it was pushed to make the corneal incision, until the point of the knife is just in the edge of the pupil nearest the angle of the corneal wound at which the puncture was made. The point is then depressed so that it passes into the lens substance and the knife is pushed forward, as for the corneal section, until the point passes fairly behind the iris in the direction of the counter puncture. This completes the opening of the capsule and the knife is withdrawn."

I have seen no reason to change this method for any other that has since been proposed.

This was resorted to originally to get rid of the cystotome, because it is an instrument hard to keep clean, and to simplify the operation by using one less instrument to perform it. It was chosen after trying the Trousseau method of dipping the point of the knife into the lens capsule, as it is carried across the anterior chamber, between the puncture and counter puncture. That method does open the lens capsule in the manner desired, but at the cost of a slight change in the direction of movement and consequent loss of smoothness of the corneal incision.

Peripheral linear capsulotomy does not guard against leaving cortex in the anterior chamber, any better than does intracapsular extraction; but it can be successfully accomplished in all cases. There are no ruptures of the capsule leaving it in the eye, with lens substance in the anterior chamber. It does not get rid of the capsule in the few cases, usually of hypermature cataract, in which the capsule is much thickened; and therefore is better gotten out of the way. These are the cases in which I have done, and would still prefer, extraction in the capsule.

Smith regards the opposite condition of immature cataract as best suited to the intracapsular operation. So it may be, if by the "capsulotomy method" the cortex is to be left in the anterior chamber, or likely to fall into it during the after treatment. But cortex, even clear cortex, left within the capsule by peripheral capsulotomy is as non-irritating after a cataract operation as before it; and, if of moderate amount, is quickly dissolved and removed.

Elsewhere (16) I have reported on clinical experience with this method. Of 50 cases so treated but one had vision that was reduced to 0.2 by opacity of the pupillary membrane, and only five required needling after three months following the extraction. It seems that the clearing up of some loose thinking about the lens capsule and of the possibility of its causing aftercataract, might open the way to a more unprejudiced consideration of the clinical evidence bearing upon this question.

SUMMARY.

The capsule of the crystalline lens can rarely cause any serious impairment of vision when left *in situ* after the extraction of senile cataract. Even the epithelium lining the anterior capsule is not a source of serious danger in this connection in senile eyes.

Aftercataract is in most cases essentially composed of tissue developed from fibroblasts, which reach the capsule during a period of inflammation following cataract extraction; such inflammation being especially favored by the presence of lens substance, within the eye and outside the lens capsule.

Peripheral linear capsulotomy guards against the danger of such damage from the presence of lens substance in the anterior chamber quite as well as the more difficult and formidable operation of intracapsular extraction.

LITERATURE.

1. CHITTENDEN. *Untersuchungen d. phys. Institut zu Heidelberg*, 1879.
2. COLLINS and MAYOU. *Pathology and Bacteriology*, p. 448.
3. LANDOLT. *The Refraction and Accommodation of the Eye.*
4. TSCHERNING. *Optique Physiologique*, p. 117.
5. SALZMAN. *Anatomy and Histology of the Human Eyeball*, p. 165.
6. BECKER, O. *Zur Anat. der gesunden u. kranken Linse.* Wiesbaden, 1883.
7. HULKE. *Royal London Ophthalmic Hospital Reports*, 1857.
8. COLLINS and MAYOU. *Pathology and Bacteriology*, p. 454.
9. PARSONS. *The Pathology of the Eye*, vol. ii., p. 396.
10. *Ibid.*, p. 419.
11. LIPPINCOTT. *Trans. Amer. Ophth. Soc.*, vol. vi., p. 85.
12. KNAPP. H. *Trans. Amer. Ophth. Soc.*, vol. iv., p. 425.

13. Knapp, H., Norris and Oliver. *System of Diseases of Eye*, vol. iii., p. 798.
14. Jackson, E., *Manual of the Diagnosis and Treatment of the Diseases of the Eye.* First Edition, p. 553.
15. Jackson. *Transactions Amer. Ophth. Soc.*, vol. xiii., p. 43.
16. *Ibid.*, p. 39.

ON THE INITIAL DEVELOPMENT OF PAPILLARY BODIES IN THE HUMAN CONJUNCTIVA.

By KAZUO HIWATARI, Kagoshima, Japan.

THE surface of the conjunctiva is well known to be perfectly smooth in infants. Even in a gonorrhœal infection, which is always followed by a marked papillary growth, it preserves this smoothness in infants until the affection has persisted for some time. The reason why its surface remains smooth is easily learned from a microscopical examination of the conjunctiva, in which we find that the cylindrical epithelia, in which no beaker cells exist as yet, form a single layer over the surface of the tunica propria. The latter is at this time slightly developed, consists of some connective tissue fibers in bundles, or in a reticular structure, contains but few blood capillaries, and no traces of an adenoid character. The most important feature of the tunica propria, as conferring a smooth appearance to the conjunctival surface, is that the papillary bodies have not yet been developed, and the question arises when and how does the initial development of the papillary bodies in the human conjunctiva begin.

This question has not yet been answered, so far as I know, and the solution of the problem may perhaps be of value, not only from the standpoint of normal histology of the conjunctiva, but also for practical purposes. Nothing is said in regard to it in the monograph by Eversbusch, *Augenerkrankungen im Kindesalter*, Jena, 1912. H. Virchow quoted in Saemisch's *Handbuch der Augenheilkunde*, 2 Aufl., I. Vol. ii., S. 442, only the description of Raehlmann (v. Graefe's *Arch. f. Ophth.*, xxix., 1883) according to whom the initial development of the papillary bodies can be first observed at the fifth month after birth in connection with the development of the adenoid tissue in the tunica propria. Greeff (*Die pathologische Anatomie des Auges*, 1902, p. 10) also quotes Raehlmann. In the work of Goldzieher (*Arch. f. Ophth.*, lxiii., 1906), the subject matter of which comes into close relation to the question of the papillary bodies, no attention is paid to the subject. In short the answer to the question awaits a further, systematic, future histological investigation.

The following observation seems to me to bear upon the answer and therefore to be worthy of report.

An infant died ten days after birth, not having suffered from any observed eye disease, and the following conditions were found in the course of a histological study of the conjunctiva.

A. THE EPITHELIAL LAYER.

The cylindrical epithelia formed a single layer over the conjunctival surface with no beaker cells to be observed between them. The nuclei of the epithelial cells were large, situated in the basal portion, and stained well with hæmatoxylin eosin. In the neighborhood of the lid margin the epithelia lay in a plane, but in other parts of the tarsal conjunctiva the layer showed many small elevations and depressions caused by the papillary bodies in the subjacent tunica propria. The size of the elevations varied, some being as wide as four or five epithelial cells, others as twenty or more. The epithelia upon the elevations were separated from the underlying blood capillaries by such minute masses of connective tissue fibers that sometimes it seemed as though the former lay directly on the latter. In other words, the elevations of the epithelial layer in the form of papillary bodies seemed to be caused by a dilatation of the closely subjacent blood capillaries. The depressions of the epithelia likewise varied in size; in general they were narrow, flat, and reached scarcely to the middle depth of the tunica propria. The epithelia over them lay close together.

B. THE TUNICA PROPRIA.

This consisted of a thin layer of reticular connective tissue fibers lying between the epithelial layer and the tarsus. It contained many blood capillaries, which were especially numerous in the superficial half, where some of them caused the above-mentioned elevations of the epithelial layer. The nuclei found here belonged partly to the endothelial cells of the blood capillaries, partly to connective tissue cells; no lymphocytes and no adenoid tissue could be recognized. In the fornix nothing resembling papillary bodies could be found, except an artificial folding of the conjunctiva. The tunica propria also showed the same structure here as in the tarsal portions, with no adenoid characteristics.

It is surprising that my experience differs so far from that of Raehlmann in regard to the initial period of the papillary development. He found the first signs of this development at the end of the fifth month after birth, while I found the initial stage present in an infant ten days old. We must naturally take the individuality into consideration, but the difference is too great to be explained in this way, so I feel that a further systematic study of this question is much needed. Raehlmann and I disagree also concerning the mode of the papillary development. I have called attention to the close relation between the epithelial elevations and the blood capillaries in my case, in which no adenoid characteristics were yet present in the tunica propria, and because of the absence of the latter I cannot agree with him that the development of the papillary bodies is due to the development of the adenoid layer, which appears more than two months after birth. I am inclined to believe that the initial development of the papillary bodies is closely connected with the development of the blood capillaries under the epithelial layer. Dilatation of these capillaries gives rise gradually to elevations of the epithelial layer and the further growth of the epithelial layer itself as well as of the connective tissue, and the development of adenoid tissue in the tunica propria lead finally to the complete formation of the papillary bodies of the conjunctiva.

CONCLUSIONS.

1. The initial development of papillary bodies in the conjunctiva can be observed in infants ten days old.
2. It is introduced by dilatation of the blood capillaries growing beneath the epithelial layer. Adenoid tissue seems to

play no essential rôle in the development of the papillary bodies.

3. The nuclei of the cells found in the tunica propria in my case belonged partly to the cells of the capillary endothelia, partly to those of the connective tissue, while no lymphocytes were to be recognized.

ILLUSTRATING DR. CRIGLER'S ARTICLE ON "AN ATYPICAL CASE OF COATS'S DISEASE."

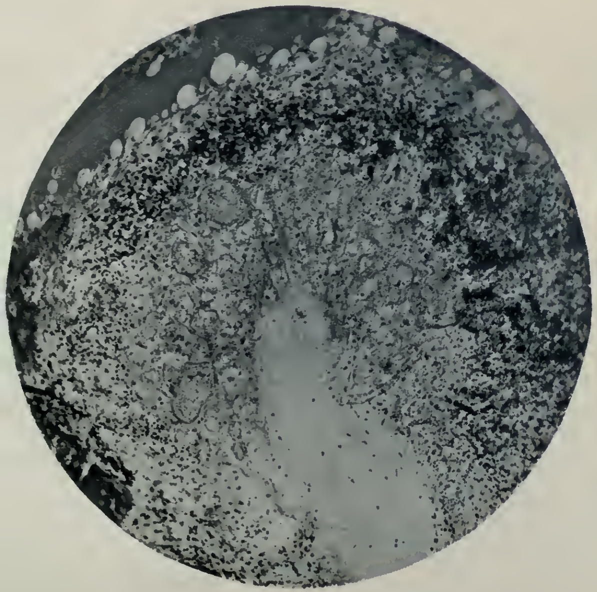

FIG. 1.

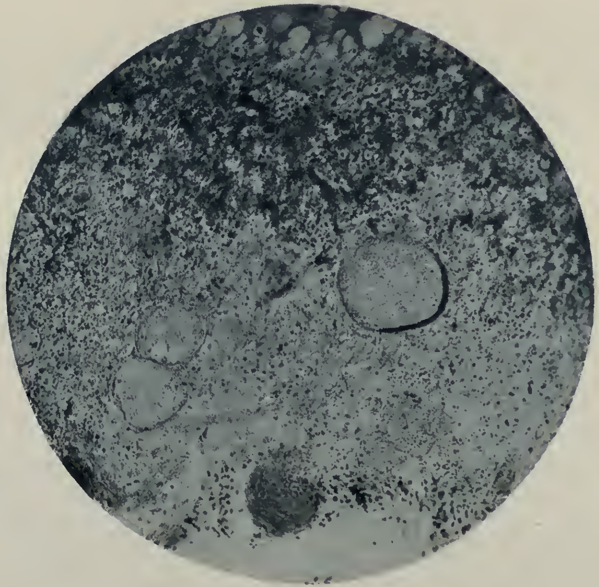

FIG. 2.

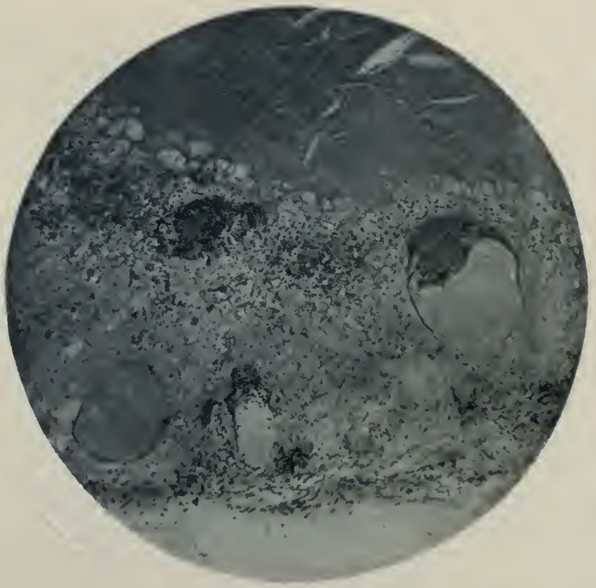

FIG. 3.

AN ATYPICAL CASE OF COATS'S DISEASE.[1]

By Dr. L. W. CRIGLER, New York.

(*With three figures on Text-Plate XIII.*)

WE are indebted to the late Mr. George Coats of the Royal London Ophthalmic Hospital for the study and classification of a peculiar form of retinal disease characterized by massive exudation beneath the retina accompanied by unusual vascular disturbances.

In addition to the previously reported unclassified cases he reported six of his own, including a microscopic study of the diseased processes. He was enabled to classify them into three fairly well-defined groups, all of which presented a fibrous subretinal exudate in common: First. Those *without* gross vascular changes. Second. Those *with* gross vascular changes. Third. Those characterized by the formation of large arteriovenous communications.

In groups one and two most of the recorded cases are in young people with negative histories and with no physical signs of disease, only one eye being affected as a rule, whereas in group three both eyes are not infrequently involved.

In group one the development and onset is slow and insidious. Changes in the anterior portion of the globe may not occur, and if at all only as a very late complication.

In group two there are more frequent exacerbations; the process may not be so chronic and the disease terminate in the loss of the eye from anterior uveitis complicated by secondary glaucoma.

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[1] Presented before Section on Ophthalmology, New York Academy of Medicine, January, 1920.

Group three is characterized by the formation of arteriovenous communications with enormous enlargement of the affected vessels in certain parts of the retina. At the point of communication a balloon-like dilatation is described which is usually red, pale red, or yellowish red in color. It may be covered with hemorrhage or have fine vessels on its surface; both the artery and vein are dilated for some distance beyond this mass, the color of the circulating blood in both being the same. Pathological examination in this group of cases seems to reveal but little in common with the two former, except the existence of the subretinal exudate, and Coats is inclined to classify it as "a true vascular new formation in the retina."

The subject of this report was a young American girl, age 14. The case was of unusual interest not only on account of its rarity but owing to the fact that the retinal changes could be studied at intervals over a considerable period of time.

The case was first seen by me on December 27, 1916. She gave a history of failing vision in the right eye for the past two years. Her family history is somewhat suggestive of hereditary lues in that her mother had four miscarriages, she being the only living child. Her personal history is negative in so far as any previous trouble with the eye is concerned except a record of an examination made by Dr. Meierhof in September, 1909, from which the following notes were obtained.

O. D. V. $\frac{20}{70}$; $\frac{20}{40}$ with + 1.75 Sph. Opaque nerve fibers and chorioretinitis.

O. S. V. $\frac{10}{200}$; not improved. Choroidal area of atrophy in macular region.

At the time of my examination her blood Wassermann was negative and her urine normal; there was no reaction to the subcutaneous injection of one milligram of old tuberculin. Her teeth and general facial development were suggestive of hereditary syphilis. There was no deafness.

Examination of the right eye revealed the following condition: Marked divergent squint; no external evidence of inflammation. Ophthalmoscopically the cornea and aqueous were clear; there were a few opacities in the posterior lens cortex; large floating veil-like opacities in the vitreous; disk margins obliterated; surrounding retina elevated unevenly between one and three dioptres, and in the lower half the elevation extended as far forward as the equator. The blood vessels were distended and in some spots near their termination there were aneurysmal dilatations and capillary hemorrhages. The nerve fiber layer was only slightly infiltrated so that the blood vessels could be seen distinctly everywhere except in the vicinity of the disk where they could be seen as through a thin veil. In the lower outer quadrant was an area of uneven outline not detached from the choroid, in which there were marked pigmentary changes, at the peripheral margin of which there were numerous minute, twisted, newly formed capillaries, some of which terminated in petechial hemorrhages. In the rest of the fundus the subretinal exudate changed the color of the normal red reflex to a cloudy white. There were isolated deposits of cholesterine crystals, presumably the site of former hemorrhages. None were seen in the advancing margin or in the vicinity of fresh blood clots. Vision was reduced to hand movements seen eccentrically.

The left eye was highly myopic, but with the exception of an old choroidal patch near the macular, there was no other pathologic evidence of disease. Her vision in this eye was improved to $\frac{20}{40}$ with a − 15. D. Sph.

This patient was seen by the members of the eye section of the Academy of Medicine when the above description obtained; later the case was shown before the New York Ophthalmological Society when the retina had become totally detached, the vitreous remaining quite clear. The disk could no longer be seen on account of the funnel-shaped detachment. Parts of the periphery previously obscured by the iris could now be seen which presented the same vascular changes already described.

The patient was allowed to return to her home in an adjoining city. On April 2, 1917, she returned with the eye exceedingly hard and painful; there was circumcorneal injection with some œdema of the ocular conjunctiva. The pupil was moderately dilated and the iris congested. She stated that the eye had been red and painful for about ten days, and that it had grown worse each day. All light perception was now lost and she was advised to have the eye removed. She was admitted to the hospital and kept under observation and treatment for a few days, during which time she developed scarlet fever and was transferred to the Willard-Parker Hospital where Dr. Wootton was kind enough to enucleate the eye for me. The patient subsequently died of acute nephritis.

Microscopic Examination.—The globe was preserved in formalin divided sagittally and cut in celloiden. Ten slides were chosen out of sixty, stained by hematoxylin and eosin and Van Giesen methods.

In each the interest focuses upon the retinal changes which are definite as to histology but elusive as to interpretation.

The cornea and sclera present only slight variation from the normal; there is, however, episcleral extravasation of blood about a tortuous and distended vortex vein, perhaps due to the trauma of enucleation. The canal of Schlemm is closed and the sinus angle is obliterated by the root of the iris which is adherent to the cornea.

The Uveal Tract.—The iris shows a rather widely dilated pupil which is pulled taut by scar tissue on its anterior surface, the crypts being obliterated and the sphincter muscle doubled backward. The iris stroma is dense and the vessels sclerosed. The ciliary muscle is thin and atrophic—its circular fibers entirely lacking. The ciliary processes are few, slender, and markedly bleached. The pars ciliaris is not interesting but shows a tendency to detachment *en masse.* The choroid is thin and atrophic in all its layers. The choriocapillaris and the lamina vitrea of Bruch cannot be seen. Of the pigment layer lining the choroid not a cell is found *in situ.* At several points on the free inner surface of the choroid are small tabs of tissue from 1 to 3*mm* in diameter composed of fibroblasts extending into areas of granular débris held together by fibrin strands and containing cholesterin crystals—presumably sites of old hemorrhages.

The lens is not interesting.

The Subchoroidal Space.—The retina is detached from the oraserrata to the papilla. A smooth coagulum marked by many cholesterin crystal crevices, fills the space between the choroid and detached retina. In this coagulum are clouds of "ghost cells" (so called by Coats) chiefly aggregated on the posterior surface of the retina. They also penetrate the retinal meshwork throughout its thickness. The cells are hydropic, rounded, pale and contain rod-shaped pigment granules and would seem to be the stratum pigmenti since they are not found elsewhere.

The Retina Proper.—The retinal layers nourished by the chorioid have disappeared, *i.e.*, the rods and cones and outer nuclear layer. The vascular layers remain but they are much disturbed—are diffuse and confluent for the most part—are highly œdematous and generally overrun by round cells but chiefly remarkable for the increase in blood vessels and totaling a thickness four times the normal. In the thinner parts the layers are less disturbed—even fairly distinct. All layers show degeneration—the ganglion cells in particular. The blood vessels are unique—are much increased in number and appear at all levels—sometimes in groups of a dozen or more, generally dilated and thin but sometimes compact and thickened. The dilated ones often measuring 250 microns (¼*mm*), have walls as thin as 10 microns with the endothelium often lacking or are mere shadows without nuclei, showing actual dissolution and permitting the blood to ooze into the surrounding tissues where it remains as a clot or granular mass or is organized in part and contains cholesterin crystals. Thrombi fill many of the vessels lumina and some are granular masses, some amorphous and hyaline and a few partially organized or show a fenestrated arrangement. Some vessels show aneurysmal dilatations—in some the blood dissects the walls into thin layers some of which collapse into the lumen or fray outward and permit extensive extravasation.

The compact vessels show thickened walls—sometimes contain thrombi and even in these the blood dissects its way outward. Many of the capillaries are tortuous and end in ampulliform dilatations. Occasional plaques of a hyaline character spread along the vessel walls. There are areas in which extravasated blood preserves a spiral arrangement as if marking the site of former vessels apparently merged in the surrounding tissues. Signs of active inflammation are scarce. We have extensive œdema, spaces filled with pale coagula, fibrin deposits, diffuse round cell infiltration and cells loaded with uveal pigment appearing in and about some of the vessel walls. Loose strands of fibrin fairly thick and some fibroblasts and round cells float from the anterior surface of the retina into the vitreous—especially in the region of the papilla—in long loop formation. Strands of fibrin are looped on the outer surface and the folds of the retina are held by fibrin threads. Degenerated areas of the retina show only loose fibrils and small scattered nuclei and shadows of blood vessels and blood extravasations. The general picture is that of a lacy veil clinging to a framework of blood vessels. The process is a sluggish one with times of exacerbations—such times marked by ruptured vessels and hemorrhages. We have old hemorrhages, evidenced by amorphous hyaline deposits with fibroblasts and cholesterine crystals—more recent ones showing granular cell débris with no activity and fairly fresh extravasations. The thrombi show the same stages.

SUMMARY.

This case presents certain features in common with those described by Coats (R. L. O. H. Reports, vol. xvii., 1908) but differs from them in several essential characteristics, the most important of which is the absence of masses of fibrous tissue between the retina and choroid; the inner layers of the choroid and the outer layers of the retina have disappeared, but the inner layers of the retina and blood vessel changes are similar *i.e.*, the increase in blood vessels, the hemorrhages, the thrombi, the granular and hyaline degenerations, the anuerysmal dilatations, the exacerbations, the peculiar changes in the vessel walls—which together with the rest of the picture seems to place this eye in group II among the cases with pronounced vascular changes.

With reference to the ætiology—to repeat—the striking feature in this case is the absence of fibrous tissue in the subretinal exudate, notwithstanding the fact that the retina had remained detached for a considerable period of time; for we have evidence of pre-existing hemorrhage by the presence of cholesterin crystals throughout the coagulum. It can perhaps be better explained on the ground that the subretinal exudate was not primarily blood but the product of a slow inflammatory process to which later blood was added, but not in time to result in the formation of connective tissue. In view of the fact that fibrous tissue is not necessarily dependent upon the pre-existence of hemorrhage in these cases (Leber) we must account for its absence on the ground that the inflammatory process was of such a destructive character as to prevent its formation and not on account of delayed hemorrhage.

It is of interest to note that this condition was probably of long standing: Dr. Meierhof's examination of the eye in 1909, revealing "opaque nerve fibers and chorioretinitis, $\frac{20}{40}$ vision" in a hypermetropic eye, strongly suggest the beginning of the trouble previous to that time.

I am indebted to Dr. L. H. Meeker for the report of the microscopical examination of this eye.

REGARDING THE ÆTIOLOGY AND DIAGNOSIS OF GLAUCOMA AND THE CONTROL OF THE DISEASE BY MIOTICS.[1]

By WM. CAMPBELL POSEY, M.D., Philadelphia, Pa.

THE task allotted to me by your Chairman is a discussion of the ætiology of glaucoma, its predisposing causes, its early diagnosis, and its prevention, or, as I take it, its control when detected in its incipiency, by miotics, diet, etc.

PATHOGENESIS.

Generally speaking, there are two chief theories which have been advanced to account for the rise in pressure, one the hypersecretion theory, which contends that it is due to an increase in secretion, as a consequence of some form of nervous irritation, the other, the so-called retention theory, that it results from a mechanical obstruction which is offered to the outflow of fluids from the eye.

DeWecker, Galezowski, and Schweigger were the chief exponents of the hypersecretion theory originally advanced by von Graefe and Donders which made all forms of glaucoma dependent upon the condition of the sympathetic nervous system. This theory, however, has been controverted by the repeated observations which have been made both clinically and experimentally that no appreciable change in the intraocular tension may follow considerable alteration in the sympathetic system.

In a comparatively recent paper, Lagrange holds to the hypersecretion theory, and believes it to be the primary cause of glaucoma, the hypersecretion being due to a nervous disorder (excitation of the sympathetic), and to an alteration in the blood or the vessels (sclerosis). He believes that one of these factors may suffice, but when they act together, the effect is so much the greater. While hypersecretion is the principal cause, Lagrange, however, asserts that there is speedily added another factor of capital importance, namely, the obliteration of the excretory channels, thereby harmonizing the theory of hypersecretion with the so-called retention theory.

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[1] Read by invitation before the section on Ophthalmology of the New York Academy of Medicine, January 19, 1920.

The retention theory is based upon the fact that according to the researches of Knies and Weber, and Priestley Smith and Collins, every eye the seat of primary glaucoma is predisposed to the disease as a consequence of certain peculiarities in its build. This predisposition depends, as Fuchs puts it, on insufficient spatial relations, which may either affect the eye as a whole or particularly the region of the anterior and posterior chambers. Priestley Smith has proven, in a manner that is conclusive to most ophthalmologists, that a want of space between the crystalline lens and the parts which surround it is a frequent predisposing cause of primary glaucoma. As long as the circumlental space is patulous, the eye is free from the disease but as soon as this space is contracted, the lymph secreted from the ciliary body becomes dammed up in the vitreous, which increases in volume, and pushes the lens and iris forward, reducing still more the depth of the anterior chamber. After a time if the increased tension is maintained, the root of the iris becomes agglutinated to the cornea at the angle of the chamber, and the chief avenue of escape of the intraocular fluids is permanently blocked.

While the evidence seems quite conclusive as far as primary glaucoma is concerned, that the increased tension results in a disturbance offered to the outflow of the fluids within the eye, nevertheless the retention theory cannot explain all cases and there are undoubtedly other factors present in very many instances.[1]

Thus, a number of writers have endeavored to prove the influence of arteriosclerosis in producing glaucoma, the vascular disturbance operating in various ways to create the rise in pressure; Fuchs, Schnabel, Birnbacher, and Czermak thought by obstructing the outflow of the intraocular fluids in the veins; Stölling, by altering the composition of the ocular fluids; Sulzer and Zimmerman, by lowering of the arterial blood pressure; Bajardi and Joseph, by increasing the blood pressure; Terson, by œdema of the vitreous, etc. After a careful analysis of these theories, Röhmer concluded that while there is no doubt that this vascular disorder may have a place in the pathogenesis of the disease, the conclusions arrived at by their sponsors are premature. It is of interest to note that Priestley Smith's figures seem to show conclusively that the known relationship of chronic glaucoma to senility is not simply a matter of increasing blood pressure.

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[1] The foregoing is an abstract from the writer's chapter on "The Operative Treatment of Glaucoma," in *A System of Ophthalmic Operations*, edited by Casey A. Wood, N. Y.

Some time ago I reviewed the records of my glaucoma cases, to ascertain possible ætiological factors, and found nothing tangible, with the exception of gout, or a so-called rheumatic tendency. This corresponds with the conclusions arrived at by Zentmayer and myself in an analysis of 167 cases of chronic glaucoma which had occurred in the services of the late Drs. W. F. Norris and C. A. Oliver, whose assistants we were in the Wills Hospital, for out of this total it was elicited that 21 had had distinct attacks of rheumatism.

Certain facts in connection with glaucoma have been proven. For example, we know that the tendency to glaucoma increases with age and that past middle life exhibits the best soil for its growth, although senility and extreme youth are not exempt. Men are slightly more liable than women, and this is especially true of cases occurring prior to 60 years of age. Although small eyes are predisposed to glaucoma, the character of the ametropia present has no relationship in inducing glaucoma. The influence of heredity cannot be gainsaid, as Elliot aptly puts it, being revealed both in the race and in the family. The liability of Hebrews is recognized and Elliot thinks the disease abnormally prevalent in India. Priestley Smith attributes the ætiological factor in hereditary glaucoma to the transmission of eyes abnormally small and suggests that the cornea of all individuals from a suspected stock be measured, so that in the event of the diameter being found too small, precautionary measures may be taken. Glaucoma is a binocular affection and Zentmayer's and my figures showed that in the cases studied by us an average period of twenty months intervened between the manifestation of the symptoms in the two eyes.

Diagnosis.—No time need be lost, before such an audience, in outlining the signs characteristic of the inflammatory types of glaucoma, so I shall confine myself to a brief review of the earlier changes which may be observed in the chronic type of the disease. Before describing these, it may not be amiss to consider for a moment the symptoms which actuate patients with chronic glaucoma to consult a physician. Let me here, if I may, again cite the paper just referred to, for, of the 167 cases analyzed by Dr. Zentmayer and me, it was noted that 39 sought treatment on account of failing sight, 19 on account of presbyopia, 19 on account of ocular pain, 3 on account of asthenopia, whilst it was accidentally discovered, in a number of instances, in individuals who sought relief from external affections, such as foreign bodies, etc. Halo was noted in but 8 cases; muscæ in 7.

Glaucoma is essentially a disease which is attended by loss in the visual acuity, but the absence of this symptom, as is well recognized, does not preclude the possibility of the hardening process, for in 36 eyes in which we found other well-marked symptoms of the disease, central visual acuity was normal. When reliable information is desired of the visual condition, a study of the fields is of course imperative.

After loss of sight, headache is the most prominent symptom, 44 patients stating that they suffered from it. This symptom did not affect all similarly; 11 described it as being temporal in character; 14 as frontal, 7 as occipital, while in 3 instances it took the form of a hemicrania. Eight asserted positively that they never had any pain in the head.

The most constant of the signs of glaucoma visible upon simple inspection is shallowing of the anterior chamber, due in most instances to a forward displacement of the lens. Though suggestive of glaucoma, a shallowing of the chamber does not necessarily indicate increased intraocular pressure, for it may be occasioned by a lens of excessive thickness or be due to an advance of the anterior surface of the lens of natural growth.

Nor is the size of the pupil in the early stage of much help, for in most instances there is but slight if any departure from the normal, either in size or reaction. The cornea is clear and there is seldom sufficient enlargement of the scleral vessels to declare that they are actually engorged.

Ophthalmoscopically the first thing to excite the suspicion of glaucoma is the tendency of the scleral ring to become visible all around the disk and its disposition to broaden, especially to the temporal side. This broadening of the ring goes hand in hand with the extent and depth of the excavation, though it usually precedes any definite cupping of the disk. Zentmayer and I found this sign in 147 of our cases; 33 times in beginning cases; 56 times in excavations to the temporal side; 40 times in complete excavations; 7 times in large shallow excavations, and 11 times in physiological excavations.

It is unnecessary here to dwell upon the characteristics of the excavation in the head of the nerve almost pathognomonic of glaucoma. It was present in 81.43% of all the eyes Zentmayer and I tabulated. Although the excavation shows a marked predilection to occupy the temporal half of the disk, no part of the nerve escapes. In some cases it appears at the temporal edge of the disk as a continuation of the physiological excavation. From here it gradually spreads over the head of the nerve, encroaching upon its structure until only a narrow rim of nerve fibers remains at the nasal edge.

Other signs of increased intraocular tension, such as the choroidal halo and the venous and arterial pulses, occur in such a small proportion of early cases that they cannot be looked upon as constant factors of the disease and their absence cannot be regarded as negative evidence for the existence of a glaucomatous state.

A limitation in accommodation will be found in about 40% of all cases.

Much which was conjectural regarding the diagnosis of chronic glaucoma twenty years ago has been proven, by our increase in knowledge concerning intraocular tension and the extent of the visual fields, and no ophthalmologist can consider that he has made a thorough test of any case until it has been subjected to a tonometric examination and a proper study of the field of vision for small objects, as outlined by Bjerrum, Seidel, Rönne, and others. But as I understand these two important subjects will be treated by others, I will pass at once to my concluding topic, the control of glaucoma in its incipiency by miotics, diet, etc., and here again I shall confine my remarks to chronic glaucoma, as the profession is agreed, I think, as to the employment of miotics in the acute forms of the disease.

In addition to the paper already quoted, I have upon other occasions called attention to the value of miotics in chronic glaucoma. Thus, in 1908, I analyzed a series of 65 cases, of which all but 7 had been observed over a period of two years, and 12 for more than ten years, and the results attained by the constant and prolonged use of these drugs were favorably compared with a similar series of cases treated by iridectomy. Among the percentages deduced from this analytical study, it was found that central vision was maintained in the miotic series, each of whose cases was observed over an average period of five years and eight months, in 80% of the cases, in comparison with 25% in the most favorable group of iridectomized eyes. In 1914, I published additional details regarding 13 of the cases reported in the 1908 group, and added an analysis of 18 new cases which I had also followed over a prolonged series of years.

Of the cases remaining from the 1908 series, but 22 eyes could be analyzed, as 3 were blind when they came under observation and 1 had been iridectomized.

Of the 22, 17 eyes were either normal or showed but the earliest traces of glaucoma at the first examination; in three the disease was moderately advanced, while in 2 the glaucomatous process had progressed to such an extent that but little vision remained. Fourteen eyes of this first group retained practically normal vision and field as long as they were under observation, a general average of ten years. Three went blind while under treatment, in five, six, and ten years respectively. Of the 3 eyes in which the disease was but moderately advanced, 1 went blind in two years; the others maintained vision eight and ten years, respectively. The results attained in the 2 eyes in which the disease was farthest advanced were strikingly good, vision and field being maintained without further loss in one case for ten years, while in the second but a slight loss was recorded during the same period. Of the 18 cases reported for the first time, but 24 eyes were capable of analysis.

Of these 24, 13 showed but the rudiments of the disease at the first examination, the glaucomatous process was moderately advanced in 8, while in 3, central vision and the visual field were greatly compromised. In the first group, practically normal vision was maintained while the cases remained under observation, for periods ranging from five to eighteen years, an average of seven and one half years. In the second group of 8 eyes, vision was maintained for periods ranging from two to ten years, an average of about four years, while in the 3 eyes which were in the most advanced stage of the disease, vision was maintained for periods ranging from one to six years, an average of three years.

The figures obtained by the analysis of these 31 cases agree in large measure with those published in connection with the 1908 series, and it may be remarked that just as the advocates of operative measures find beginning cases to be more amenable to treatment than those in the more advanced stages of the disease, so cases treated by miotics from the early stages give better percentages so far as the maintenance of central and peripheral vision is concerned.

It is evident, from the foregoing, that in miotics we have a very valuable means of controlling chronic glaucoma in very many instances and that the prognosis is not so unfavorable as is at times given; but, as insisted upon in all my communications upon the subject, to obtain proper results, the drug must be used constantly and continuously, that is to say, at the end of every third or fourth hour, and every day, without interruption, through life. And here the limitation of the miotic treatment manifests itself, for the element of the human equation now comes into consideration, and I confess with increasing years of observation and experience, that I am compelled to include more and more cases each year in the class of those "in which there is doubt of the patient's coöperation in the persistence in the miotic treatment throughout the remainder of life." Time and again I have been chagrined to discover that my instructions have been misunderstood or willfully neglected by most intelligent and responsible individuals, so that

I find myself, as the years go by, counseling operation more and more, not because I question the efficacy of the miotic treatment in suitable cases, but on account of my doubts as to its being faithfully adhered to.

In analyzing my attitude in regard to miotics and operation, I find that I have finally arrived at the following. Operation is counseled in all cases where there is doubt of the patient's willingness or ability to coöperate in the miotic treatment. In view of the probable long duration of years in which the treatment may have to be employed, I advise operation on the most affected eye in subjects under fifty-five years of age, miotics being employed in both the operated and unoperated eye for the remainder of life. Operation on the second eye should follow if vision is found to be better maintained in the operated than in the unoperated eye. Operation should also be resorted to in all cases in which the disease progresses despite the faithful use of the drug for a period of six weeks or two months.

The following regimen should also be prescribed in each case: massage of the eyeball; careful refraction at not infrequent intervals; restriction of the use of the eyes at close work; a proper amount of exercise in the open air; favorable climatic conditions. The skin should be kept active, the gastro-intestinal apparatus regulated, and any local source of inflammation or irritation, neighboring on the eyes, such as inflammation in the nasal passages or their accessory sinuses, should be allayed. Particular care should be given to the peripheral circulation, nitroglycerin and strophanthus being often of value. Strychnine should be administered, not only on account of its action on the circulation, but also because of its influence on the optic nerve. On account of their anti-rheumatic properties, the salicylates are of decided value and should be administered frequently for continued periods. Patients should abstain from the use of tobacco and alcohol and should, in so far as it is possible, be relieved from business and other cares.

THE TONOMETRY OF GLAUCOMA.[1]

BY WILLIAM McLEAN, M.D., NEW YORK.

(With one illustration in the text.)

AS a preface to my paper I would like to report the result of the experiment made the early part of this evening in which so many of those present were kind enough to participate. To those who did not get a chance to examine the apparatus I will explain that we had a manometer of standard type to which was connected a freshly enucleated pig's eye. With this apparatus we were able to produce any desired intraocular pressure and have that pressure indicated by the manometer.

The technique employed in each test was to start with a subnormal intraocular pressure and gradually increase the pressure until the oculist by finger palpation estimated the pressure to be normal. The intraocular pressure was then increased until the examining oculist estimated it to be at the upper limit of normal.

In general the intraocular pressure had to be raised somewhat above 20*mm* before the eye was considered above subnormal. The lowest upper limit of normal, with the exception of one man, was estimated to be 35 while the highest upper limit was given as 46. Most of the men making the test gave pressures for the upper limit which ranged within 36 and 42 *mm* Hg. I have tried this same test on two previous occasions. In one the average upper limit was 42 while the average for the other test was 40.5*mm* Hg.

Most if not all of the symptoms of glaucoma can be explained on the ground of increased intraocular pressure. While the phenomena attending many of the symptoms of glaucoma are already admitted and can be directly traced to an increased intraocular pressure, theories tending to prove that increased pressure is accountable for other symptoms seem just as logical as the theories presented for other agents, as the causative factor.

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[1] Read before Section on Ophthalmology, New York Academy of Medicine, January 19, 1920.

The pallor of the disk, the peculiar depression of the floor of the disk (the so-called glaucomatous cupping) which Elliot says is, next to increased intraocular pressure itself, the best known sign of glaucoma, the alteration in the vessels and in their direction as they pass from the center of the disk to the surface of the surrounding retina, the changes in the visual fields, the photopsiæ, pains, alterations in the shape and size of the different chambers of the eye, and the diminution of vision, are all either admittedly due directly to increased intraocular pressure, or the theories that can be advanced that increased intraocular pressure is the cause are to me quite tenable.

The time allotted to me for this paper, and the subject assigned me, preclude my entering into a discussion of those theories. Thus it may be seen that the subject of increased intraocular pressure at once becomes one of the main features of the broad subject of glaucoma.

What constitutes increased intraocular pressure? In other words what are the limits of normal intraocular pressure? In giving directions on the use of my tonometer I have placed the limits of normal as between 22 and 40*mm* of mercury manometer pressure as registered directly on the scale of the tonometer. Those readings must not be confounded with the Schiotz instrument. Their values are different.

The McLean tonometer can be adopted as a routine of the ophthalmologist's examination without adding more than three minutes to the time allotted for the examination of each patient. I have had communications from oculists telling me that since adopting the McLean tonometer they are making many more readings, as with that instrument there is no time lost in adjusting or changing the weights, and in translating the reading from the chart or table. The average time I allow for the reading is about two minutes, which includes the time from the instillation of the drops to the finish of the reading. I have found the Allison chair most serviceable for office practice, as with that chair the patient can be placed in a comfortable semi-reclining position quickly, and with the headrest properly adjusted the head is in a position so that the eyes are looking vertically upward.

The steps I pursue in making a reading are as follows: instil a drop of holocain 1% in the eye or eyes to be tested; allow about one minute to elapse, then tilt the chair backward to the proper angle so that the eyes can look comfortably, directly upward to the ceiling. An easy way to get the patient to look directly upward is to have a black disk of about six inches diameter painted on the ceiling vertically above the head of the patient.

By a spreading motion with the thumb and finger of one hand lift the upper and lower lids from the eyeball, and with the other hand place the footplate of the tonometer squarely on the center of the cornea under examination, and read off the deflection of the indicating needle directly in *mm* of mercury manometer pressure. One good reading with the tonometer placed squarely in the center of the cornea, and especially if there is a regular oscillation of the needle of 1 to 6*mm* is to be preferred to an average of three or four possibly faulty readings.

Where an oscillation occurs the lower limit of that oscillation is to be considered as the intraocular pressure of that eye. Those oscillations are synchronous with the heart pulse, and the range, in a way, simulates the systolic and diastolic pressures of the blood.

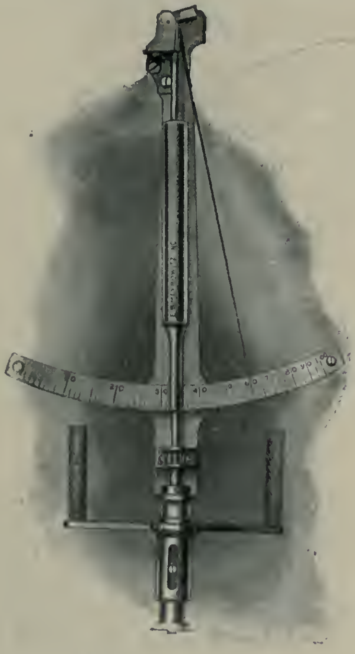
I doubt if there can be a fixed upper limit above which we can say there is glaucoma, and below which there is no glaucoma. By that I mean that one patient may have an intraocular pressure which for that patient is perfectly physiological while that same pressure in another patient will be pathological. I have fixed forty as the upper limit of safety because I have never found a normal eye which registered above forty although I have found a number of normal eyes that did register as high as forty. On the other hand I have found a few eyes that registered 36 with the McLean tonometer and 22 with Schiotz in which symptoms of glaucoma were present. There are to be found in the literature a few cases which presented symptoms of glaucoma with the intraocular pressures below the upper limits of normal.

Singularly the normal young adults I tested, those not above twenty-five years of age, frequently presented intraocular pressures between thirty-five and forty while those of more advanced years, above sixty, who did not present symptoms of glaucoma, frequently gave readings below 30*mm* of intraocular pressure. Those findings are similar to the reports of other writers.

I believe the few cases of glaucoma simplex that present unmistakable evidences of the presence of the disease but yet show with the tonometer an intraocular pressure within the limits of normal are to be divided into two classes. One class are those in which the lamina cribrosa stretches under a pressure that can be firmly sustained by the lamina cribrosa of the average individual. Fuchs concurs in this view, and says: "there are cases of glaucoma simplex in which the tension is never found distinctly increased. In these cases we must assume that the lamina cribrosa is particularly yielding so that it is forced backward by a pressure that does not perceptibly rise above normal limits."

The other class are those that give histories of attacks of blurred vision, halos, and uncomfortable feelings in the eye, but an interim examination with the tonometer will reveal a pressure well within the upper limit. Those are cases that I believe present transitory increases of intraocular pressure of considerable magnitude. One writer recently reported a case of that type which gave a history that would lead one to think of transitory attacks of glaucoma. He made a reading with the tonometer and pronounced the pressure as normal. Later he was called to the house of the patient and found her suffering from an attack of glaucoma. Not having his tonometer with him he took the tension by finger palpation and pronounced it "stony hard." He prescribed miotics for immediate use and much to his surprise the case promptly regained its previous condition.

I might cite a case that was referred to me four years ago which presented the following: vision with correction $\frac{20}{20}$ +; there had been attacks of disturbed vision as though looking through a fog, and the street lamps had a halo of colored rings. She had recently been in the hands of two oculists one of whom had made a diagnosis of glaucoma and wanted to operate although at that time none of these symptoms were present and the Schiotz recorded 18 as the intraocular pressure. She refused the operation and the oculist prescribed pilocarpine for constant use, which at that time she did not tolerate well. At the time of my first examination her subjective symptoms of glaucoma were not present, and the McLean tonometer recorded an intraocular pressure of 34 in the right eye and 33 in the left. However, the fields for form and color were very slightly constricted. There was a very pretty physiological cupping, and the vessels were not changed in course or appearance.



McLean Tonometer

She has been under my observation since, but in the four years has not had an attack just as she related in her history. Tonometer readings taken during the four years have ranged from 30 to 36. With the exception of one period in September, 1916, miotics have not been used, and the glaucomatous picture has not increased. In September, 1916, she came to me and reported that there had been a sensation in the right eye similar to the sensations experienced at the beginning of previous attacks. At that time the tonometer recorded 36 as the intraocular pressure. Pilocarpine 1% was prescribed and the attack never culminated. At her last visit, a short time ago, her vision was $\frac{20}{20}$ +, the tonometer recorded 30 in the right eye and 33 in the left, and the fields and fundi had not materially changed.

Orr reported a case of glaucoma simplex with cupping of the disks without perceptible rise in tension, and explained it by rises of pressure so slight as to be within the normal limits for the average eye.

In making tonometer readings I always use holocaine as an anæsthetic, as the anæsthesia takes place quicker than with cocaine, its effects are more transient, and yet it offers plenty of anæsthesia for the operation. In the possible presence of glaucoma it is safer than cocaine. I have known of acute glaucoma following, within a few hours, the use of cocaine, but aside from the one case reported in the literature I do not know of holocaine producing that unfortunate sequela.

Tonometer readings taken while the patient is under deep general anæsthesia are not to be considered as representing the true intraocular pressure of that patient in the conscious state. The deeper the anæsthesia the lower will be the tonometer readings.

If I may be permitted, I would like to repeat the report I gave before this Society of the experiment in which the vitreous chamber of three living human eyes, *in situ*, was connected directly to a manometer, and corresponding tonometer and manometer readings made. Since reporting these three cases, I have been further favored with the privilege of making a similar test on a fourth eye. I ask your indulgence because of the extreme rarity of this test. Aside from the four I have made, I have been unable to find any similar report except one case each by Weber and Wahlfors.

In my first case tonometer readings were made on both eyes under holocaine anæsthesia. The pressure of the affected eye was recorded as 75 (Schiotz) while the healthy eye registered 19 (Schiotz). Immediately afterward under ether, the affected eye registered 45 Schiotz and the healthy eye 10 Schiotz. A canula of *2mm* bore with a valve which was closed was thrust into the vitreous chamber well back of the ciliary processes. After everything was in readiness and the position of an air bubble in a glass capillary tube 30 inches long which contained but 10 minims of fluid was noted, the valve was opened. It was found that a manometer pressure of 65*mm* was necessary to maintain the bubble at its original mark. With the needle in the vitreous chamber we were able to make tonometer readings and compare them with the manometer. These readings were as follows: Manometer pressure, 65*mm* Hg; Schiotz tonometer indication, 50*mm*.

On the second human case tested, readings were made of the affected eye only. Before general anæsthesia a Schiotz tonometer reading of 88*mm* was made, and at the first reading under general anæsthesia the Schiotz recorded 72*mm*. The canula was immediately inserted, and the Schiotz again recorded 72, which shows that the insertion of the needle made no change in pressure. The valve was opened connecting the interior of the eye with the manometer, and a manometer pressure of 88*mm* was required to keep the air bubble in its original position. As the anæsthesia was increased corresponding tonometer and manometer readings were made which were:

Manometer	86	Schiotz	tonometer	72
“	81	“	“	54
“	72	“	“	47

As the anæsthetic was continued there was no decrease of intraocular pressure below 72 manometer so the experiment was concluded and the eye enucleated.

The experiments on these two cases were made before I had my tonometer completed, but on the third and fourth cases both the Schiotz and McLean tonometers were used.

With the third case on account of the condition of the patient we were allowed time to make only one reading with each instrument, and those were made after the patient was thoroughly anæsthetized. The readings of this case were Schiotz, 40; McLean, 58; and the manometer registered 60.

On the fourth case under holocain a reading was made of 46 Schiotz and 70 McLean. After the patient was etherized, a reading was made of 43 Schiotz and 62 McLean. The needle was inserted with the valve closed as in the other cases, and the Schiotz again recorded 43 and McLean 62. The valve was then opened and a manometer pressure of 65*mm* of Hg. was required to maintain the bubble at its original position.

The indications were:

in the first case the Schiotz recorded 50; and manometer 65
" " second " " " " 72; " " 88
" " third " Schiotz 40; McLean, 58; " " 60
" " fourth " " 43; " 62; " " 65

In all of these cases except the third there was a very free oscillation of the air bubble which was synchronous with the heartbeat, all the time the valve was open, and in the third case it was fairly good. This oscillation showed that the interior of the eye and the manometer were in free communication and that we can rely on the manometer as giving us a true indication of the intraocular pressure of the eye.

In making tests to obtain some data regarding intraocular pressure, I have made records of 9736 individual readings on actual eyes where the interior of the eye was connected directly with the manometer. The eyes used were human, pigs', cats', dogs', and rabbits'. In the four living human cases above recited and in a number of the animal experiments, corresponding tonometer and manometer readings were made both *in situ* and after enucleation. Both water and mercury manometers have been employed. Of tonometers Schiotz, Gradle, and McLean were used; in all over eight hundred tonometers were employed in making these tests.

VISUAL FIELDS IN GLAUCOMA.[1]

By LUTHER C. PETER, M.D., Philadelphia, Pa.

(With five figures in the text.)

A STUDY of the visual fields in glaucoma reveals the following facts:

(1) Central vision as a rule is preserved until a late stage of the disease.

(2) Color fields are usually present in the central zone until concentric contraction has made great inroads upon the perimacular area.

(3) Peripheral field changes are usually first observed in the upper or lower nasal quadrants and subsequently either take on a concentric contraction or an irregular quadrant defect which eventually becomes continuous with the blind spot of Mariotte.

(4) Central defects consist of an enlargement of the blind spot of Mariotte and of arched or sickle like scotomata which radiate from the blind spot above and below the macula; these scotomata usually begin in the peripheral field and travel towards the blind spot although their development may progress towards the periphery and towards the blind spot.

These facts are substantiated by clinical experience. Special interest centers in the reasons for the bizarre types of changes as compared with other forms of atrophy. I believe, therefore, that the time allotted to this phase of the subject can be most profitably spent in a discussion, first of the arrangement of the retinal nerve fibers and the retinal circulation, second, the evolution of the process which gives rise to the perimetric symptoms in glaucoma, and third, the variations in the perimetric findings.

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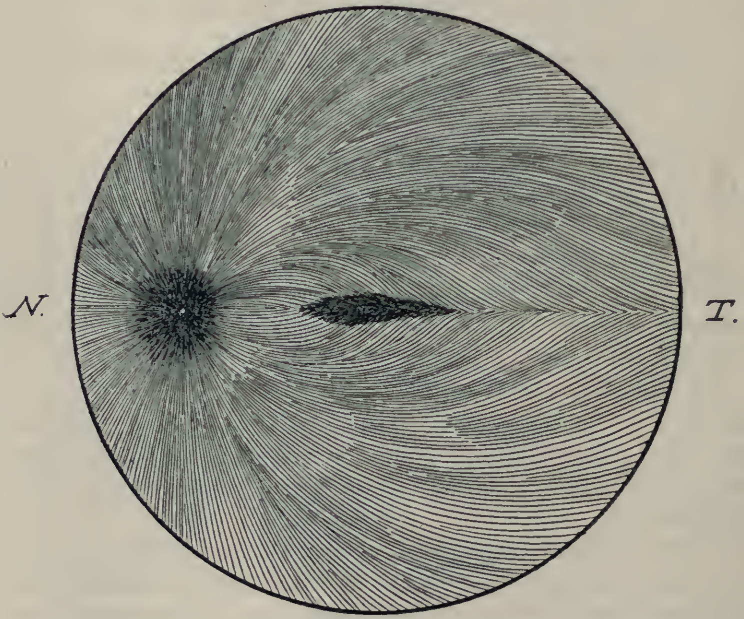
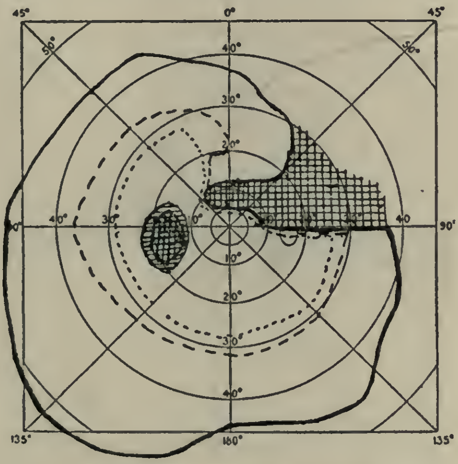
[1] Read at the Section on Ophthalmology of the New York Academy of Medicine, January 19, 1920.

According to Saltzmann and other anatomists the nerve fiber lair of the retina has a very definite arrangement. For the most part the fibers pass in a radial direction toward the optic nerve. To the temporal side, however, this regular and direct arrangement does not obtain. The papillomacular bundles pass, as it were, from a horizontal raphe in the macular region, arching slightly above and below this raphe towards the disk. The fibers just beyond the temporal side of the macular raphe form almost a half circle. In order to reach the optic nerve the extreme temporal fibers must pass above and below this macular area of nerve bundles and, therefore, are decidedly arched and bowed. In the accompanying cut the arrangement is diagrammatically and graphically illustrated. In the stretching process, to which the nerve fibers are subjected, it is readily understood, therefore, just why the peripheral nasal fields should be the first to show evidence of



Distribution of retinal nerve fibers

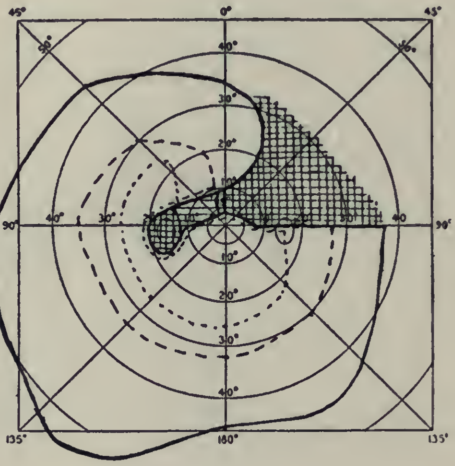
shrinking. Associated with this definite arrangement of nerve fibers should also be mentioned the scant blood supply of the temporal region as compared with the nasal side of the retina. This distribution of the retinal arteries is so well understood that it needs no further explanation. The latter anatomic peculiarity paves the way for a better understanding of the early nasal shrinkage in acute congestive attacks of glaucoma, and the former, contraction of the same parts of the field during the development of the more chronic process.



Fields of a case of chronic glaucoma, illustrating the development of Bjerrum's sign. Taken 7-11-17

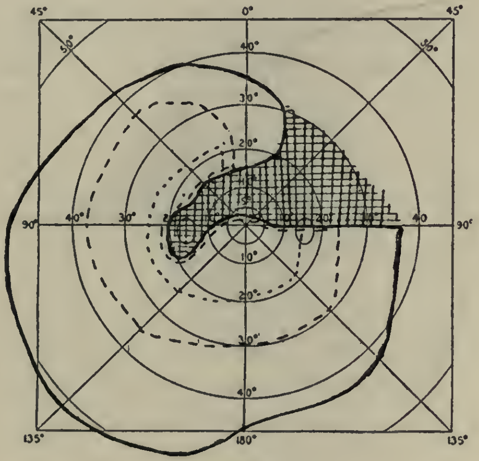
In the evolution of the glaucomatic cup the diminished blood supply to the temporal retina and blocking of the functional activity of the extreme peripheral fibers are both in evidence. The papillomacular bundle occupies a relatively large part of the optic nerve. The macular raphe is well supplied with short direct and relatively more numerous nerve fibers than the peripheral retina. This fact explains the first of the accepted statements, namely, that central vision usually remains unimpaired until sight is about to disappear. The fibers in this area are superimposed to a greater extent and are more readily preserved in their physiologic activity than the longer, scantier, and less protected temporal fibers.

Above and below the macular bundles, the fibers are particularly vulnerable because they are relatively few in number, of much greater length and are exposed to a greater stretching process as the optic cup recedes and they are brought in contact with the sharp resisting edge of the cup. This particular vulnerability accounts for the first evidence of peripheral field change, namely, the upper or lower nasal cut. To a fully developed sector of lost function, caused in this manner and extending up to and including the blind spot of Mariotte, has been assigned the name of Bjerrum's sign or symptom. In its formation when the shrinkage begins in the peripheral field and is in process of expanding toward the blind spot, Rōnne has defined the defect as a "nasal step." One rarely finds sharp angular defects in perimetry and their presence in "field taking" is usually due to inelastic and inaccurate methods of study. In these "nasal steps," however, found in glaucoma, one often notes sharp lines and angles. Just below the macular raphe, for example, one may find a field extending to its full normal limitations whereas the bundle above the macula may be destroyed and a sharp knife-like division will, therefore, be noted in the field. A fact which is not generally noted is the preservation of the color fields up to the meridian passing through the macular raphe along with that for form.



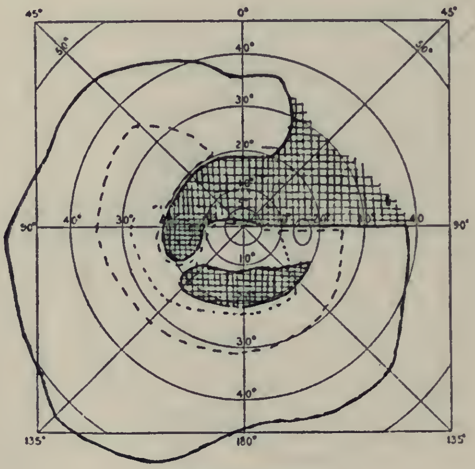
Taken 9-11-17

Seidel has added a third sign to this group of central defects in the glaucomatic field, namely, an enlargement of the blind spot of Mariotte above or below, simultaneously or successively. If this enlargement progresses Seidel's sign is supposed to develop into Bjerrum's sign. In view of this claim it is interesting to study the fields of a case which I have had under my care for some years. In the upper nasal quadrant there is a typical Bjerrum's sign with the stages of its development well illustrated. Under the point of fixation is a Bjerrum's sign in the making, a development of the last two months. Note that the upper defect has developed from without. It has advanced towards the blind spot—the logical manner as one would conclude from our knowledge of the minute anatomy of the retina and its blood supply. The inferior scotoma, however, is advancing in both directions but more definitely so towards the blind spot. That some of the peripheral parts are functionating is evidence that certain bundles have thus far escaped. In marked contrast to the atrophies usually observed, primary, secondary, and consecutive, in which the process is a descending one, that of glaucoma is an ascending disease. This difference is especially noticeable in the behavior of the colors, with a discussion of which we will conclude this paper.



Taken 5-7-18

That enlargement of the blind spot occurs in all cases of glaucoma with or without Bjerrum's sign is easily demonstrated. It is, however, a rather symmetric defect and is easily explained. Fuchs has called our attention to the fact that the most peripheral optic nerve fibers terminate immediately beyond the optic nerve in the retina; or to speak more correctly the retinal nerve fibers immediately surrounding the optic disc pass into and form the most peripheral part of the optic nerve. As the resulting pathology in glaucoma is largely centered in the nerve head or cup, these most peripheral of optic nerve fibers must necessarily be involved early in the stretching process. An enlarged blind spot, therefore, is a natural sequence.



Taken 12-30-19

Color Fields.—When, as it sometimes happens, the fields for form are concentrically contracted and no angular defects are noted, color fields suffer some but not in the same proportion as is noted, for example, in primary optic atrophy. Color sensation is preserved in the central zone at times when only small islands for form are left. In primary optic atrophy we usually find color defects precede that noted in form, and color sensations may be absent when form is recognized in a fairly large central area. This preservation of color sensibility in the central zone until a late period in the history of glaucoma is due to the better nourishment of this part of the retina. Peripheral loss undoubtedly is nutritional in origin; that is, the periphery suffers first from a deficient blood supply and second from its remoteness;—conductivity from the peripheral field is more readily interrupted by the stretching process as explained above. As color is not well represented in the most peripheral parts of the retina, color defects are only pronounced as the color zones are invaded.

In the sector defects the color loss is early and a good forerunner of the rapidly approaching absolute scotoma. In this it follows the rule in nerve fiber degeneration. Above and below these sector defects, however, it is to be noted that color sensation is preserved up to the line of demarcation as outlined by the white test object, providing this preserved area does not show signs of atrophy.

In glaucoma simplex, when increased intraocular tension eludes detection, the anterior chamber is normal in depth and the glaucomatic cup is sufficiently questionable to raise a point of differentiation between primary optic atrophy and glaucoma simplex, the young ophthalmologist and those of more mature experience will find this behavior of the color fields a nice point in the differentiation.

In short, throughout the course of the disease, from its inception until blindness supervenes in a glaucomatic eye, the campimeter in its various modifications, will furnish the vade mecum which will guarantee a safe and intelligent guide in the management of this most unfortunate disease.

THE OPERATIVE TREATMENT OF GLAUCOMA.[1]

BY DR. JOHN E. WEEKS, NEW YORK.

IN considering the operative treatment of glaucoma in the short time at my disposal, it is expedient to mention the principal forms of glaucoma and speak of the operative procedures best suited, in the opinion of the writer, for the treatment of each form.

Congenital glaucoma, of which buphthalmos is the principal form. The pathological anatomy in buphthalmos presents almost total closure of the lymph spaces at the filtration angle in virtually all cases, making it apparent that nothing but a filtering cicatrix will be of any value in the operative procedure. The fibrous coat is thin and to some degree elastic, making a large opening in this coat dangerous to the integrity of the globe. Sclerotomy, iridectomy, and cyclodialysis are not calculated to obtain a satisfactory filtering cicatrix. The Lagrange operation would succeed better, but the sclera is so thin that the ordinary triangular piece of sclera cannot be readily obtained and the wound is apt to gape and to be inadequately covered by a conjunctival flap. The site of the attachment of the ciliary body, the annular ligament, is far from the corneal margin and the conjunctiva extends well over a relatively wide zone in front of this attachment, making it easy to trephine under a liberal conjunctival flap, without injuring any important structure. The trephine opening can be very satisfactorily covered. On account of the thinness of the fibrous coat a large trephine should not be used as some enlargement of the opening usually occurs as a result of stretching of the sclera. I therefore recommend for this operation a trephine not to exceed 1.5*mm* in diameter. If the iris presents, a piece as liberal as can be easily secured should be excised. In very young infants with buphthalmos, paracentesis subconjunctivally employed may be of much temporary benefit.

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[1] Read before Section on Ophthalmology, New York Academy of Medicine, Jan. 19, 1920.

Juvenile glaucoma (precocious senile) a term used to indicate the development of glaucoma in early life, is so closely allied to the ordinary senile glaucoma that no distinction need be made in considering the surgical treatment. Senile glaucoma may be conveniently divided into congestive and noncongestive glaucoma, and the congestive form into acute and subacute. In all forms of juvenile and senile glaucoma the iris angle is encroached upon. For a relatively long period of time the iris angle is not obliterated but is in the congestive cases temporarily closed and again becomes open. In the chronic cases a long period of partial closure precedes the final obliteration. In congestive glaucoma there is but little of a sclerosing process affecting the sclerocorneal junction in the earlier stage, but in noncongestive glaucoma (simple chronic) the sclerosing process apparently advances from the beginning, obliteration of the iris angle being a more or less delayed phase of the development. An understanding of the anatomical changes that take place in glaucoma and the chronological order of these changes enables the operator to select the operation best suited to the individual case.

What are the indications for operation in glaucoma? Broadly speaking, in all cases of confirmed glaucoma in which diminution in the size of the visual field and diminution in the acuity of vision cannot be wholly prevented by the use of remedies, principally miotics, operation should be resorted to. In acute congestive glaucoma an attempt to relieve the acute symptoms, extending over a period of six to forty-eight hours, should be made in order to have the eye in the best possible condition for the operation. In regard to the time for operation, all experienced ophthalmologists agree that the earlier the operation is performed the better are the chances for a successful and satisfactory result.

Iridectomy. The classical iridectomy does not contemplate the forming of a filtering cicatrix. How then does it do good in glaucoma?

1. In the early stage of glaucoma iridectomy by removal of iris and traction on the remaining iris opens up the iris angle and permits of the free escape of fluid from the eye.

2. By excising iris tissue additional lymph spaces in the iris tissue are opened and aqueous humor finds more ready exit through the lymph channels and veins of the iris than occurred previous to the iridectomy.

If these are the things accomplished by the classical iridectomy it is easy to determine in what class of cases iridectomy can be employed to best advantage, namely, in the very early stage of all varieties of congestive glaucoma and in the, if possible, earliest stage of noncongestive glaucoma, or before the sclerosing process has advanced to any great degree and before the iris has become adherent at the iris angle and has begun to atrophy. Iridectomy in the later stage of glaucoma, unless employed with the aim of producing a filtering cicatrix, is of little value. Particularly is this a fact as regards noncongestive glaucoma. This was fully recognized by von Graefe who was insistent on the necessity to perform iridectomy in the very early stage of the disease in order that the results might be satisfactory. When are we to select an operation that contemplates the establishment of a filtering cicatrix? This question may be answered by the statement that such an operation should be selected so soon as the lymph spaces at the filtration angle and in iris tissue are permanently closed to the extent that removal of iris tissue cannot restore a normal balance between the inflow and outflow of intraocular fluids. When this period of transition between the choice of operations is reached in the various cases is not always an easy matter to determine, particularly in the noncongestive form of glaucoma. However, it is better to err on the right side, that is, it is better to choose an operation permitting of the establishment of a filtering cicatrix earlier than is necessary rather than later than is necessary. There have been numerous operations devised for the formation of a filtering cicatrix. Only a few of the more promising will be mentioned: "Major Herbert (*Trans. Ophth. Soc. U. K.*, vol. xxiii., 1903) has devised a number of operations all for the purpose of obtaining a cystoid filtering cicatrix. He made a large sclerotomy with a large conjunctival flap and produced a large prolapse of the iris.

The wound healed, the prolapse being covered by the conjunctiva. As the iris tissue resisted the passage of fluids, he finally excised a small piece of iris, establishing a fistula at once. Herbert reported the results of 130 operations. In 13 the iris was left intact; in 5 iridotomy was performed; and in the rest iridectomy was performed. The relief of tension was certain and permanent, although in some cases this was not established until massage and miotics had been used for periods of two to three months. He held that the risk of late infection was small and that early serious complications were less frequent than in similar cases operated on by a broad iridectomy. Herbert claims that this method is better able to provide a permeable scar than any other. He admits that there is some risk of infection and that sympathetic ophthalmia may result, but that both are so infrequent that they may be disregarded.

Holth (*Annales d'Oculist.*, March, 1907) makes an incision either with a linear knife or with a keratome. With the former the incision is made 6 to 8*mm* long at the limbus with the formation of a conjunctival flap. With the latter the conjunctiva is pierced 8*mm* from the corneal margin in order to supply a conjunctival flap. The point of the keratome is advanced subconjunctivally to 1*mm* from the corneal margin, where it is made to pierce the sclera, and the incision 6 to 8*mm* long is made in this plane. An iridotomy or iridectomy is done, the iris drawn into the angle of the scleral wound and left incarcerated (iridencleisis) or slightly prolapsing. Holth reported a series of 41 operations and, in a later paper (*Annales d'Oculist.*, July, 1909), a series of 87 operations. In the total number of operations he obtained 85.3 per cent. of filtering cicatrices. He had no bad results. Some of the cases were satisfactory when examined two months to two years after the operations.

Borthen (*Archiv f. Augenheilk.*, Bd., xlv., 1909) reported having done fifty similar operations for the production of a subconjunctival prolapse of the iris in simple and absolute glaucoma. He claims to have obtained the desired results in every case.

Maher (*Ophthal. Rev.*, 1909, p. 185) endeavors to produce a cystoid scar by opening the eye as far as the usual iridectomy, dragging a portion of the iris from its ciliary attachment, leaving the loop thus produced prolapsed for a week and then excising it with the scissors, close to its scleral attachment at each angle of the wound. Sometimes the iris was cut at one angle of the wound at the time of the operation and left hanging at the other angle. Plastic iritis followed in one case. Maher admits the liability of infection, but does not consider it of much importance. The Lagrange and the Elliot operations are so well understood that a description of the technique is not necessary here. The operation of Verhoeff is a modification of the trephining operation, and need not be considered separately.

A study of the reported results after the Lagrange and after the Elliot methods leads one to conclude that the one is about as effective as the other in the treatment of glaucoma. The choice of either will depend on the experiences of the individual operator. It is probably safe to say that these two methods are superior to any others that have so far been devised.

Secondary Glaucoma. In my practice, secondary glaucoma is encountered in about 4 per cent. of the cases of cataract extraction. In some of these cases the capsule of the lens appears to be the cause.

It has occurred to me a few times that after a cataract extraction the iris on one or both sides of the coloboma in combined extraction and extraction after preliminary iridectomy has become incarcerated in the angle of the wound. Hypertension has developed subsequently in some of these cases. If the anterior chamber is opened at a suitable place and the columns of the coloboma on the incarcerated side are freely divided, the hypertension will be relieved in the majority of such cases. There are some cases of hypertension following cataract extraction, not due to either of these causes, which may be relieved by operation. In one patient coming to me after operation for the removal of cataract by a colleague, a trephining, made at the outer part of the coloboma, a 1*mm* trephine being used, gave permanent relief. In a case of simple extraction by me, hypertension developed about six weeks after the uncomplicated extraction. In my absence from the city Dr. Herman Knapp performed the usual iridectomy, permanently relieving the hypertension. The patient was subsequently under my observation for eight years. The tension of that eye remained normal.

In secondary glaucoma accompanying acute or subacute iritis, the hypertension will as a rule subside spontaneously in a few days. At times, operative procedure becomes necessary. In these cases paracentesis, one or more times, followed by opening the wound every second or third day, is usually sufficient. The paracentesis should be made at the limbus, pushing a narrow flap of ocular conjunctiva before the point of the knife, so that the wound at the sclerocorneal margin will be covered when the knife is removed. Rarely an iridectomy upward is required.

The secondary glaucomas that follow sclerokeratitis, or after interstitial keratitis, are not usually successfully treated by a simple iridectomy. In these cases, since the glaucoma follows the partial closure of the lymph spaces at the sclerocorneal junction by the sclerosing process following the inflammation, a filtering cicatrix must be obtained by some form of operation in order to give permanent relief from the hypertension. Such a filtering cicatrix must be obtained in virtually all chronic cases in which the anterior chamber is deep.

I have performed the Elliot trephining operation sixty-four times. Unfortunately, I have had intraocular hemorrhages follow in two cases, iritis in six cases, detachment of choroid in two cases, return of tension from blocking of the opening in a number of cases, and late infection in two cases. At present I limit the use of this method to buphthalmos, some cases with deep anterior chamber, and to cases of chronic simple glaucoma, mostly with relatively low hypertension. The Lagrange operation, which I have performed at least three hundred times, is relied on for the forms of glaucoma other than those reserved for the Elliot operation. The operation is performed as described by Lagrange, except that the incision is seldom more than 5*mm* long (Lagrange advises 7*mm*). The shorter incision is employed to avoid the danger of prolapse of the head of the ciliary body or of the lens into the wound, and to lessen the possibilities of escape of vitreous. In this series of cases there has been deep intraocular hemorrhages twice. The openings have been occluded by the falling forward of the head of the ciliary body in four. There has been loss of vitreous in three cases. Hypertension has recurred in a small percentage of dispensary cases because of inability to have the after-treatment followed up; but in private cases, hypertension has recurred to an extent to nullify the result in only four instances. There have been but two light cases of iritis and no case of late infection.

In employing this operation the after-treatment is very important. Massage should be practiced daily, beginning forty-eight hours after the operation in all cases in which the tension is not subnormal, for the purpose of gently forcing a very small quantity of the aqueous through the scleral opening, causing the conjunctiva covering the opening to bulge slightly. The massage should be continued a few days or weeks, as is found necessary, to secure a filtering cicatrix. The patient can be readily instructed how to perform the massage, and the after-treatment can then be conducted without the presence of the surgeon. The results in private patients have been most satisfactory. It is my opinion that the Elliot operation will give a higher percentage of permanent relief of hypertension in patients who cannot have satisfactory after-treatment, as in dispensary practice; but in private practice a greater percentage of satisfactory results, in the class of cases mentioned, can be obtained by the Lagrange method.

In regard to late infection, this has been met with in cataract extraction followed by cystoid scars, as well as after the Elliot and the Lagrange operations. In all procedures in which a cystoid filtering cicatrix is made there is undoubtedly some danger of secondary infection—the thinner the wall of the cyst the greater the danger. In the writer's opinion all patients with cystoid scars should be cautioned to cleanse the eyes at least once daily with a bland aseptic solution in order to guard against infection of the conjunctiva that might lead to infection of the globe.

Eyes with "idiopathic" glaucoma of the nonacute type are subject to degenerative changes even after the correction of the hypertension and we must not expect as high a percentage of such eyes to retain the vision present after a successful operation as would obtain after iridectomy for other conditions. Eyes with advanced degenerative changes, particularly the chronic cases in which atrophy of the optic nerve is considerable, not infrequently continue to degenerate, but more slowly, after hypertension has been completely and permanently relieved.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

An ordinary meeting of the Section was held on February 4th, under the presidency of Mr. W. T. Holmes Spicer, F.R.C.S.

Mr. G. Winfield Roll showed a patient who **exhibited new-formed vessels on the iris.** The history of the condition dated from infancy. The right eye had a number of vessels on the front of the iris, radiating from the periphery to the margin of the pupil. The eye was blind, and somewhat disorganized, and it having recently become painful, the patient was anxious to part with it. The good eye showed areas of coloboma in the fundus, that below the disk appearing like a congenital one in the choroid. A floating band in the vitreous came forward to the back of the lens, but Mr. Roll was unable to trace it to its attachment. The patient was highly astigmatic, namely, $\frac{6}{12}$ with prism. He asked for suggestions as to causation.

Mr. E. Treacher Collins pointed out that some of the vessels of the iris seemed to turn round the pupillary border, others were in front of the lens capsule. He thought the condition was probably the persistence of the fœtal vascular system. When the eye had been removed he believed there would be found a patent central hyaloid artery.

The President spoke of having seen a certain number of similar cases, and in one case it was inflammatory, an old iritis and cyclitis case, followed by increased tension. At that time he was not clear as to how far the prolonged use of eserine increased the growth of the vessels.

Dr. A. Hugh Thompson showed a case of **macular detach-**

ment of the retina, probably by new growth. His colleagues advised excision of the eye without delay. Four months ago, there was very little to see: the macula was not raised more than 2 d., and the diagnosis was by no means easy. Since then, however, there had been a regular gray detachment, and it was steadily increasing. There had not yet been any increased tension. If the cause was a new growth, it occurred exactly at the macula, which was not a common site for growth.

Mr. H. GRIMSDALE showed a case of **pulsating exophthalmos of sixty-five years' standing;** the case was exhibited in 1883 by the late Mr. Frost. It followed on a street accident. In the literature the statement was generally made that the prominent feature of these cases was paralysis of the third nerve. In the few cases he had seen, however, it was the sixth nerve which was most markedly paralyzed. This man had complete action of the third, but paresis of both sixths. In a case he recently saw, in which rupture occurred without traceable cause, the first symptom was diplopia, due to paresis of the external rectus. It was what one would expect, seeing that the sixth was lying well within the pressure area, so that its conductivity would be interfered with comparatively easily.

Mr. C. HIGGENS related two cases of the condition which came on during labor, and in a few months cleared up spontaneously.

Mr. J. H. FISHER said the cases of the kind he had seen had not been notable for paralysis of any of the extraocular muscles, but he agreed that the sixth was the most likely to be paralyzed. He believed there were two classes of cases. The first were definitely due to a fractured base, which lacerated the carotid artery; and obviously the sixth, the nerve lying on the floor of the cavernous sinus, would be the nerve most likely to be implicated; the third nerve, being higher in the sinus, would be likely to escape damage. In the second class of case he thought there was usually a history of a fall, rupture of a diseased artery being the first trouble, this disturbance of circulation resulting in the fall, the latter being therefore the secondary phenomenon. Here again the most likely nerve to be injured was the sixth.

Mr. NORMAN B. FLEMING showed a case of **gunshot wound of both occipital lobes, with eye trouble.** The wound was due to shell fire, and there was a deficiency of the vault of the skull over an area, roughly circular, 2½ inches in diameter, in the mid-line, the lower part of the aperture being one inch above the inion. At the casualty clearing station, fragments of bone and metal were extracted; there had been no later operation. He now complained of headaches, giddiness, slight deafness on the right side, and some loss of sight, though central vision was acute. The eyes presented no objective abnormality. The visual fields suggested complete destruction of the dorsal part of each visual cortex.

Mr. J. H. FISHER said such men when hit were, frequently, totally blind for days, and in lateral hemianopic cases there was direct laceration and damage of one half of the vision center, and a concussion effect in the other half, causing some œdema of nerve tissues, and punctiform hemorrhages, some of it capable of recovery, but a small amount not.

Mr. N. BISHOP HARMAN showed a case of **new growth in the eye of a boy, which members considered to be a glioma.** The mother said she noticed the eye shone unduly when the boy was fourteen months old. Now, the whole fundus was covered with a number of round bodies, of various sizes. A month ago, signs of irritation commenced. He proposed to remove the eye, but the parents were very difficult to persuade.

Mr. ELMORE BREWERTON held strongly that any child under six years of age who had a white mass in the vitreous, with increased intraocular tension, should have the eye removed. This eye certainly showed an increased tension.

The Radical Cure of Gonorrheal Iritis.

Mr. S. H. BROWNING, bacteriologist to the Royal London Ophthalmic and All Saints' Hospitals, contributed a paper on this subject. He said that gonorrheal iritis, being a late sequela of gonorrhea, was not usually seen at first-hand by a venereal disease specialist, hence it was, often, not treated as a local affection. He contended that very few, if any, cases of gonorrheal iritis ought to occur, and certainly there should not be recurrent cases if proper treatment were carried out. His object in reading the paper was to show that by thorough treatment of the genito-urinary tract in subjects of gonorrhea, the iritis would be permanently cured.

He regarded gonorrheal iritis as a toxic condition, that it was not due to the actual presence in the eye of the gonococcus. In only one case had the organism been isolated from the eye itself, and that was in Sidler-Huguenin's case, in which it was discovered in the blood-stained exudate from the anterior chamber of a case of gonorrheal septicæmia. The author had himself tried many times to cultivate the organism from the exudate within a few seconds of it being drawn off, but had always failed.

In these cases there was usually a history of gonorrhea some years previously; he had never seen a case of iritis during the acute stage of urethritis, and others had confirmed this, on the observation of many thousands of cases. There is, in these cases, a specific reaction to gonorrheal vaccines. It is not invariably associated with gonorrheal rheumatism. There is a recurrence of the iritis, or an exacerbation of the symptoms after prostatic and vesicular massage, probably on account of toxins being thereby liberated into the blood stream. The diagnosis is also helped by eliminating such sources of infection as pyorrhœa, septic tonsils, ear trouble, cystitis, and alimentary affections. The complement-fixation test had not given reliable results in his hands.

He considered treatment under two heads: preventive and radical. The first of these rested with those who saw such cases early; he laid great stress on the need for thoroughness at the hands of a genito-urinary specialist, for in that case he believed there would be no such condition as gonorrheal iritis. Though vaccines did not materially shorten the acute stage of the disease, complications and sequelæ were largely prevented by their use.

The radical treatment should consist of (1) immediate treatment by the ophthalmic surgeon; (2) the immediate use of vaccines; (3) continued treatment by vaccines and prostatic and vesicular massage, with, if necessary, treatment of the urethra. While an autogenous vaccine is being prepared, he urged the use of suitable doses of a reliable mixed vaccine. Some of the loss of repute of vaccine therapy in this connection he attributed to the haphazard use of commercial vaccines. The proper dose of vaccine varied with each patient; his own range of experience varied between five millions and five hundred millions. Vaccine therapy was no more than an aid to medical and surgical treatment; it was not a substitute.

The author then proceeded to outline the proper method of carrying out massage of the prostate and vesicles.

He did not think iritis was often due to other bacteria found after massage, such as staphylococci, B. coli, diphtheroids, etc. He had not met with a case of gonorrheal iritis in a female. He narrated the leading facts in the histories of ten cases which he had carefully followed out, and which bore out his contentions; he had notes of 47 cases of the condition.

Mr. C. H. MILLS strongly urged that no form of massage should be commenced until the acute stages of the iritis had subsided; the same remark applied to vaccine injections. Again, vaccine injections should never be given when massage was being carried out, because the latter expressed into the general circulation a large dose of toxins; that was especially important if the toxins had not been detoxicated. Men who had pyorrhea as well as gonorrhea seemed very likely to have joint troubles and other evidences of metastasis. But all cases of iritis which had a septic focus in the prostate or vesicles were not necessarily gonorrheal iritis, even though, years before, the patient might have had gonorrhea. He believed that in many of the cases the original gonorrhea died out, but a mixed infection succeeded and flourished on the areas originally damaged by the gonococcus. Colonel Young, of the American Army, had been conducting a research on rheumatoid arthritis, and he was keen on tracing some connection between this and chronic vesiculitis. From three hundred subjects of rheumatoid arthritis he had excised the vesicles, and from most of them he had isolated a streptococcus. Mr. Mills considered that in towns and cities 80% of the adult population had had gonorrhea at some time of their lives. The cases of iritis which did best with vaccine treatment were those in whom it occurred within about three years from the infection, for these people seemed capable of a generous manufacture of antibodies.

Mr. C. HIGGENS related two cases in which the disease in the eyes ceased to recur at about sixty years of age: one had vaccine treatment, the other did not. He attributed the cessation at that age to the patient having by then used up his stock of toxin, and not placing himself in the way of receiving a fresh supply.

Mr. Bishop Harman raised the question of carriers of the gonococcus, especially in its relation to marriage.

Mr. C. B. Goulden and Mr. William Lang continued the discussion.

Mr. Whiting spoke of the marked negative phase which occurred after giving vaccine, and which was sometimes alarming, though he had seen no ill consequences from it. It was followed by a very definite positive phase. He urged the importance of thorough treatment of the gonorrhea at the hands of specialists.

Mr. Mills and Mr. Browning replied.

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. E. M. ALGER, Secretary.

DECEMBER 15, 1919. DR. ARNOLD KNAPP, CHAIRMAN.

Dr. J. Herbert Claiborne reported a case of **wood alcohol poisoning ending in blindness and death.**

The patient was a man of 40 who had been accustomed to drinking regularly. Two days before Dr. Claiborne had seen him he had been drinking freely. The following morning the patient arose early, went out, and returned about half past nine, quite intoxicated, and complained of feeling badly, but made no reference to his eyesight. Dr. Claiborne was called to see the patient, and on entering the house noticed the odor of wood alcohol which became stronger as he reached the first story, where the patient lay in bed in a general spasm, purple in the face, and struggling violently. His eyes were bulging, pupils fully dilated, and irresponsive to a flashlight. The fundus showed pink optic nerves with blurred outlines, and congested veins, the picture of a commencing optic neuritis.

The patient's general condition grew rapidly worse, and his color changed to almost black, the pupils contracted, and the patient died, apparently from asphyxiation.

The liquor was obtained in a bar-room at 74th Street and Amsterdam Avenue, where several cases of poisoning have recently been recorded, one going blind and two becoming desperately ill in a hospital.

Dr. Claiborne is convinced that the present legislation against alcohol in general has produced a greater number of cases of wood alcohol poisoning than would ordinarily have been the case. In his opinion these cases should be published as widely as possible, and the place at which the alcohol is obtained made public.

DISCUSSION: Dr. AQUIN S. KELLY: I was asked to see a young man of 36 two days after Thanksgiving, who was confined to his room without medical attention and who felt perfectly well in every respect except that his vision was very dim, and to use his own words, he became alarmed on that account. His pupils were dilated and reacted sluggishly to light, his vision was reduced to hand movements in the right eye, and fingers at three feet in the left; fundus examination showed a moderate degree of swelling of optic nerve-heads and complete obscuration of disk margins; the veins were quite tortuous and there was a general congestion of the retinæ.

I had him removed to a general hospital and instituted treatment by means of hot packing, brisk catharsis, and sodium bicarb. by mouth, also the ingestion of large amounts of water. While in the hospital examination of fields showed absolute central scotoma. He improved very slowly and after keeping him in the hospital for a week under vigorous treatment his vision was only fingers at three feet in both eyes, and that is what it is at this date (December 15th). The swelling of the nerves gradually receded towards the end of the week, and when he left one could make out disk margins; the nerve-heads appeared pale however.

This young man was a member of a coterie of congenial spirits who met every afternoon before their dinner at a rather prosperous looking saloon at the corner of 74th Street and Amsterdam Avenue. On Thanksgiving eve they had their customary meeting and this young man had two Bronx cocktails; he does not know what the others took but four are dead and one is blind.

I understand that this saloon-keeper has been arrested, but is now out on bail.

Dr. COLMAN W. CUTLER: The urgency of the present situation is apparent and it is well that it has been brought to our attention by Dr. Claiborne's dramatic narrative and by the report of Dr. Kelly's cases.

There can be no doubt that the number of cases of wood alcohol poisoning exceeds all records. The occurrence of the epidemic may be regarded as a by-product of prohibition; this is not within our field. The fact, however, that there are many more cases of death and blindness from wood alcohol poisoning than are recorded indicates that the laws regarding the reporting of such cases are deficient and that many cases are not recognized by the medical profession.

Mr. GORDON BERRY, Field Secretary of the National Committee for the Prevention of Blindness, has collected the available data from July to December, inclusive, of course incomplete but providing a basis for the belief that the menace is very real and increasing.

I would propose that the Chairman of the Section appoint a Committee to act, with power, in connection with the Committee on Public Health of the Academy of Medicine.

The Chairman appointed as such committee, Drs. C. W. Cutler, Ward Holden, and N. L. Wilson. Dr. Holden being unable to serve, the Chairman appointed Dr. E. M. Alger in his place.

Dr. E. M. ALGER presented a woman of 30 with a complete atrophy of the nerve in the left eye and a hysterical reduction in vision in the other.

She was apparently a perfectly well woman till over a year ago she was involved in the explosion of one of the large munition plants. A ceiling fell on her head but without cutting it or stunning her. During the following bombardment by exploding shells she was not hit, but during her escape she discovered that she could see very little. As a result of exposure she developed double pneumonia and it was after convalescence from this that she discovered that she was entirely blind in her left eye. From that date vision in the other also became more and more defective.

Dr. Alger saw her first two weeks ago. She presented at that time a very unusual atrophy of the left nerve, there being not a sign of a blood vessel left except one or two fine white lines. It could be accounted for perhaps as a congenital defect, or as the result of a fracture at the apex of the orbit, or of a hemorrhage into the sheath of the nerve, though he had never seen one with so few remains of circulation.

The right eye appeared practically normal but its vision was only $\frac{3}{200}$. In the endeavor to explain this it was discovered that her field was extremely contracted without apparently affecting her ability to avoid obstacles or causing her any mental depression. At this time tests of her cutaneous sensitiveness showed no anæsthesias.

More complete examination a week later showed a vision of $\frac{20}{200}$, vision being improved to $\frac{20}{70}$ by the suggestion that a light blue glass ought to improve it somewhat, and to $\frac{20}{50}$ when a red glass was put over the blue. She read No. 3 Jager, without much difficulty. Her field of vision was contracted to an exact 5 degree circle, being exactly the same for white and red and green. When the distance from the screen was doubled and quadrupled the area of vision on the screen remained exactly the same (tubular field). At this visit it was discovered that the left side of her face had become anæsthetic, showing the suggestibility that has been supposed to account for most hysterical symptoms. Later on this anæsthesia involved at least the arm and hand and cervical region on this side. In spite of the contracted field she avoided obstacles easily and was able to go to and pick up small objects tossed across the room.

The chief interest in these cases, Dr. Alger thought, was the association of hysteria with an organic lesion and the difficulty of evalvating each. We were apt to assume that an organic lesion might justify almost any defect of vision, while the discovery of the stigmata of hysteria was often used to disprove organic damage. As a matter of fact hysterical subjects are as likely to have organic lesions as other people, while on the other hand an organic lesion or trauma in a suggestible person may lead to the first attack of hysterical symptoms.

Papers on Hypertrophy of the Pituitary Body.

Dr. WARD A. HOLDEN: By way of historical introduction to the subject of the evening I beg to show again a number of drawings I made to illustrate a paper read before this section twenty years ago called, "The sequence of changes in the optic chiasm produced by acromegalia, as exemplified in three cases" (*Arch. of Neurol. and Psychopathol.*, vol. ii., 3–4, 1899).

It was my good fortune at that time to secure autopsy material in three cases of hypertrophied pituitary body. The drawings show how the enlarging pituitary body first compresses the chiasm from behind and below, then cuts it through from behind, sparing for a time a narrow anterior bundle of fibers which is stretched far forward, and finally ruptures even this anterior bundle, thus cutting through all the crossing fibers in the chiasm and producing absolute bitemporal hemianopsia.

One drawing shows also a sella turcica greatly enlarged in all dimensions—the anterior wall pushed forward nearly to the optic foramina, the anterior clinoid processes and the optic foramina spread far apart laterally, the floor pushed downward, and the posterior wall with its clinoid processes distorted and forced far backward.

These are the local changes that the hypertrophied pituitary body produces in the soft optic chiasm which rests upon it and in the bony sella turcica in which it lies.

Dr. H. M. Imboden spoke on the **X-ray findings.** Some of the earliest experiments made with the X-rays, shortly after their discovery, was to determine their use in brain tumors. Very early it was learned that very few tumors were demonstrable. All sorts of explanations were made to account for this, but if we remember what the nature of the X-ray is, it is easy to see why so few tumors are demonstrable on the plate. X-rays are a form of radiation. The wave lengths are so short that they penetrate certain forms of matter. Some of the rays are absorbed while others pass through. The more dense the material through which they pass the greater the absorption. Consequently bones and similar structures absorb a relatively large amount, while flesh, etc., absorbs relatively little. It is easy to see therefore that as the substance of brain tumor is almost of the same density as brain substance, it is impossible for the X-ray to demonstrate it. The same pertains to cysts and abscesses. Brain tumors, however, in which there is calcific material will cause distinct shadows. The early workers readily recognized these facts and they observed the secondary effects upon the cranium itself produced by tumors and it is these manifestations which are of such great assistance in the diagnosis of brain lesions.

In spite of these early observations, however, many modern writers and practitioners are still of the opinion that a brain tumor should show, and many of those have plates made for them in a commercial laboratory and make their own diagnosis, and attribute all sorts of art defects, such as finger marks, chemical stains, etc., to brain lesions. The fact that the squamous part of the temporal bone overlies the sella and that it does not cause as dense a shadow as the surrounding bone has given rise to diagnosis of brain tumor. The technique of making these plates is very important and if we recall that the sella is placed in a sphere the length of whose shorter radius is about two inches we can see how slight a variation from straight lines will produce bizarre effects.

The secondary effects in the cranium from brain tumor are due first to increased intracranial pressure and they consist in absorptive changes in the floor. Second, absorptive changes in the vault which produce a peculiar wavelike effect. Third, increase in the groovings over the meningeal vessels.

Theoretically tumors within the sella (acromegalia) enlarge it in all diameters, the floor is thinned, the dorsum is thinned and pushed backward. The anterior clinoids frequently remain normal but may be pushed outwards or sometimes they are undermined. The other changes found in it are enlargement of the accessory nasal sinuses, thickening of the skull, and unusual prominence of the occipital protuberance.

Tumors just above the sella produce a flattening of it. The clinoids are thinned out giving the sella the appearance of widening while the floor is pushed down. These changes are theoretical only as they may be simulated by other tumors of the base. Malignant disease of the sphenoid bone causes a diminution in density of the bone, but in reality it is very difficult to differentiate it from the other types, especially when the disease is of long standing.

Dr. D. A. QUICK read a paper on **radiotherapy** and Dr. WALTER TIMME discussed **glandular therapy.** Both papers appear in full in this issue.

DISCUSSION: Dr. ELSBERG said that he had not, in his personal experience, seen any benefit from the radium treatment of tumors of the pituitary gland, but that he had seen a very marked improvement in some patients by treatment with posterior lobe extract. As is well known, the eye symptoms from pituitary disease may follow one of several types. The classical condition is one of bitemporal hemianopsia and usually the condition of one eye is far advanced over that of the other, so that one often sees patients blind in one eye with a large temporal defect in the other. But it is not so rare for a patient with pituitary tumor to have a homonymous hemianopsia resulting from pressure of the tumor laterally upon the optic tract rather than upon the chiasm itself. In a number of instances the treatment with extracts of pituitary gland has caused a marked improvement in the eye symptoms, and in at least two patients entire disappearance of eye symptoms with return of fields to the normal. This has persisted for a number of years. In other patients in whom there had been a steady diminution in the visual fields and deterioration of vision, the pituitary treatment from the time it was begun had prevented an advance in the symptoms, so that the patients held the vision which they had at the time treatment was begun. It was the speaker's opinion that unless the symptoms were extremely far advanced, every patient with field defects in pituitary disease should have a course of pituitary treatment, and in these patients the pituitary extract should be given hypodermatically. Occasionally it is of advantage to add thyroid extract, given internally, to pituitary treatment.

The discussion was continued by Dr. B. W. KEY and Dr. HOMER SMITH.

The officers nominated at the previous meeting, Dr. A. E. Davis as chairman and Dr. Conrad Berens, Jr., Secretary, were then unanimously elected, to serve during the coming year.

BY DR. CONRAD BERENS, JR., SECRETARY.

JANUARY 19, 1920. DR. A. E. DAVIS, CHAIRMAN.

PRESENTATION OF PATIENTS.

Dr. GEORGE H. BELL presented a patient with **bilateral optic neuritis** which he regarded as due to **tonsillar infection.** The patient, male, aged 49, came to the New York Eye and Ear Infirmary on November 8, 1919, complaining of severe headaches and reduced vision. The sight R. was $\frac{20}{70}$, L. $\frac{20}{200}$. Both optic nerves showed 3 D. of swelling. They were grayish-white, blurred and swollen. The pupils were dilated and the field showed a concentric contraction. Blood pressure 260–170. Urine contained albumin, hyaline casts, and sugar; specific gravity 1027; Wassermann negative. The examination of the stool showed a highly acid and toxic condition with Gram-positive bacteria in excess. The tonsils were enlarged and the crypts contained pus.

One week later, Dr. J. J. King removed both tonsils. Four weeks later the urine was negative, blood pressure 230–150. Examination of the blood made on December 15, 1919, showed no nitrogen retention. The patient gradually improved and has had no internal treatment until recently, when treatment with iodide of potash was begun. The fields have enlarged, the swelling of the nerve heads and retina is less, but the disks still remain clouded and there are white streaks along the retinal vessels suggesting arteriosclerotic changes. On January 12, 1920, blood pressure 200–135, vision R. $\frac{20}{30}$, L. $\frac{20}{40}$.

DISCUSSION: Dr. JOSEPH BRUDER spoke of some of the common causes of optic neuritis of which Dr. Bell's patient had several. He could not see why the optic neuritis in this case was due to the diseased tonsils alone. He mentioned a patient of his who had a blood pressure of 180*mm* upon whom he performed a turbinectomy. The blood pressure was reduced to 150*mm* after the operation, but he believed that this was due to the rest in bed rather than the operation.

Dr. JAMES J. KING, who removed the tonsils from Dr. Bell's patient, spoke of the fact that he was a poor operative risk due to his high blood pressure and nephritis. He feels that local anæsthesia offers a safe method of operating in many adults where a general anæsthetic is contraindicated.

Dr. BELL said in closing the discussion that he believed the chronic condition in his case was far better and that the acute condition in the optic nerves had surely improved. Dr. Bell hopes to show in a later paper that the highly acid, toxic stools were produced by swallowing infected matter from the tonsils, thus setting up a septic process in the intestines.

Dr. GEORGE H. BELL presented a patient with **retinitis proliferans.** The patient presented a large shiny white mass of connective tissue in the fundus of the left eye. Newly formed blood vessels could be observed running into the mass, extending out from the retina into the vitreous. The disk could not be seen distinctly owing to the vitreous opacities. In the periphery of the fundus there were the remains of old hemorrhages. The patient gave a history of injury, and on a previous examination was told that he suffered from hemorrhages in the retina. Wassermann negative. The other eye was normal.

Dr. A. Edward Davis presented a patient with **glaucoma secondary to anterior uveitis.** The patient, M. H., aged 18, was first seen ten years ago. The family history was negative. As a child she had had scarlet fever and measles. Two months after the latter illness the left eye had become red and painful. This condition continued for four years and as the eye was entirely blind, and the pain almost constant, enucleation was performed. The eye was examined and the late Dr. E. L. Oatman reported that the anterio-posterior diameter of the eyeball measured 31*mm*, while the transverse diameter was 27*mm*. The elongation of the eyeball had taken place entirely in that part of the sclera between the ciliary body and the cornea (intercalary space). There was a small ulcer of the cornea near the limbus. The iris in its periphery was adherent to the cornea, thus abolishing the iris angle. The pupillary space was secluded by a complete annular synechia, the retina atrophied, choroid thinned, and the optic nerve showed the changes of glaucoma, the process being secondary to the seclusion of the pupil.

The remaining eye was first inflamed when the patient was six years of age. Two years later when she was first seen by Dr. Davis the vision was R. $\frac{20}{70}$ improved with a glass to $\frac{20}{30}$. The cornea was clear, the anterior chamber deep, the sclera thinned in a crescentic shape in an area posterior to the corneal limbus, up and out, through which the pigment of the ciliary body appeared. There were old posterior synechiæ. The optic disk was cupped and the vessels presented perivascular changes. Tension normal, visual field contracted.

Four years later the patient was again seen. The scleral ecstasia seemed to have increased. No further changes in the eye found. Tension was 25. The astigmatism had increased and correcting the refraction with — 3.50 D. ax. 90, the vision was $\frac{20}{20}$. Pilocarpine was prescribed and the patient was not seen again for six years. Then there was very little change excepting that there was constant slight pain, scleral bulging was somewhat greater, and tension was 28. The astigmatism had increased to 4 D. against the rule. The patient refuses operation.

A tuberculin test was given ten days ago with a positive result in all three phases.

Dr. A. Edward Davis presented a patient with **buphthalmus and subnormal tension.** The patient was a child aged 8 with a negative family history. According to the mother the right eye was somewhat enlarged since babyhood, and the left eye slightly so. To-day the vision in the right eye is $\frac{2}{200}$, L. $\frac{20}{30}$. A moderate amount of hypermetropia in each eye. The fundus shows in the right eye slight pallor of the disk without any cupping. The fundus in the left eye is normal. Tension R. 12; L. 14. This subnormal tension has always been present during the year in which the patient has been under observation.

Dr. H. H. Tyson presented a case of **aphakia** following operation for **secondary glaucoma associated with dislocated lens** in the vitreous.

History: P. W., male, aged 65 years, was struck in his left eye with a piece of wood about ten weeks previous, and had received no treatment for the following two weeks, when he applied at the Knapp Memorial Eye Hospital with vision R. $\frac{20}{40}$, L. $\frac{6}{200}$, ciliary congestion with lens dislocated into the vitreous on the nasal side, tension 52 (Schiotz), fundus hazy. Operation was advised and declined. Pilocarpine 2% solution was presented to be used every two hours. This was continued until December 17th last, when he applied for treatment for the relief of pain in his eye with tension 70. Operation was again advised and accepted. On December 18th, under ether anæsthesia, a corneal section was made with a large keratome and the aqueous allowed to escape slowly. Section was enlarged with scissors, iridectomy was performed with large Tyrrel hook and scissors, the lens came forward partly, lying obliquely in the inferior temporal quadrant where with a wire loop and gentle counter pressure it was extracted in capsule with the trifling loss of a bead of vitreous. Recovery was uneventful, and on January 1, 1920, he had vision L. with $+ 11.00 + 1.50$ c. ax. $0 = \frac{20}{20}$. Tension normal.

He considered the case of interest on account of the excellent visual result considering the traumatism and after a tension of 52 or more had existed for over six weeks, and the fact that what promised to be a difficult operation proved to be a very simple one.

Dr. L. W. CRIGLER presented a patient with an **intraocular foreign body** in the left eye. The patient was a man 44 years of age. On November 20th, while hammering a porcelain-lined spittoon, a small particle was driven forcibly into the left eye. The path of the foreign body was obliquely through the cornea, iris, and lens, lodging in close proximity to the ciliary body. The X-ray localized it as being 6*mm* back of the center of the cornea, 6*mm* below the horizontal plane, and 8*mm* to the nasal side of the vertical plane. The body measured 2 x 1*mm*. On November 28th the giant magnet was applied without any result. The eye has remained absolutely free from any irritation for one month. Opacity in the lens is enlarged, and otherwise there is no change in the condition of the patient.

Dr. L. W. CRIGLER reported a case of **atypical Coats's disease** (published in full in this issue).

Dr. L. W. CRIGLER presented a patient with **interstitial keratitis** following an **advancement operation.** The case was that of a boy of eleven years of age who had suffered from convergent strabismus for seven years. The sight in the right eye was $\frac{20}{20}$; L. $\frac{20}{40}$ with correction. The eyes were perfectly normal. Five days after the operation the cornea became inflamed and the opacity greatly involved the entire structure. A Wassermann test gave a 4 + reaction. The case has been running a typical course in the affected eye. Thus far the right eye remains free from involvement after five and one half months.

Two years ago a similar operation was performed on this boy's brother with prompt recovery. His blood was recently examined and found also to be + + + +. The mother's blood test was the same. A younger sister, aged ten, reacted negatively. Dr. Crigler thought that the case was of interest as bearing on the influence of traumatism in producing interstitial keratitis, though in his opinion the condition in this case was a coincidence.

DISCUSSION: Dr. A. EDWARD DAVIS spoke of a case of a young woman, G. F., aged 19, whose vision was perfect in each eye before the injury. The injury to the eye occurred from a fall, and was followed by a most active interstitial keratitis in one eye and the other eye became affected a few weeks later. Notwithstanding treatment, the vision was lost in one eye from leucoma of the cornea, cataract, and softening of the eyeball. The final vision of the other eye was $\frac{20}{200}$.

DISCUSSION: Dr. EDGAR S. THOMSON spoke of two cases of **interstitial keratitis following traumatism to the cornea by a foreign body.** In the first patient there was no Wassermann examination as it was before the time of the Wassermann test. In the second case the Wassermann was positive. Dr. THOMSON believes that the traumatism probably precipitated the attack in each case.

Dr. SIGMUND A. AGATSTON: The question of traumatism of an operation acting as an exciting cause, came up in a case of **Reese resection** performed by me at Bellevue Hospital (Dr. May's service). Nine days after the operation, the patient developed an iritis in the operated eye. We have not as yet had time to determine the cause of the iritis, whether it was a focal infection, or specific in origin, but it seemed as if the traumatism of the operation might have acted as a contributory cause.

The subject of the evening was **glaucoma** and was introduced by the following papers which appear in full in this issue:

Etiology, non-operative treatment. Dr. W. CAMPBELL POSEY, Philadelphia.

Tonometry and demonstration of the McLean tonometer. Dr. WILLIAM MCLEAN, New York.

Campimetry and fields of vision. Dr. LUTHER C. PETER, Philadelphia.

Operative treatment. Dr. JOHN E. WEEKS, New York.

DISCUSSION: Dr. H. H. TYSON, stated that the subject of the papers of the evening had been so ably, extensively, and interestingly presented, that little remained to be added except a brief statement of one's personal experience.

His method of treating glaucoma had been along conservative lines. In the simple, non-inflammatory variety, as long as vision, central and peripheral with tension could be maintained at normal with miotics, he continued to use them. When they failed in their mission he resorted to operation; and selected a broad, peripheral iridectomy as the operation of choice. He has had patients who have been under observation for the past fifteen years where an iridectomy had been performed in one eye and miotics used in the other, both eyes retaining normal vision and tension, with fairly good fields.

In the chronic inflammatory type he considered operation necessary, and both Elliot's trephining and iridectomies had given him equally good results. Fortunately he had not experienced any of the possible unfavorable complications mentioned in the literature as liable to occur after trephining. He considered the Lagrange operation more difficult to perform than the others mentioned, without any distinct advantage over them, it also being liable to the same complications, etc., as trephining. He said that the Lagrange is somewhat simplified if a conjunctival flap similar to that for trephining be made previous to the scleral section, as it rendered cutting of the sclera easier afterward, provided a protection for the wound, and the size of the conjunctival flap would be regulated as desired.

As to posterior sclerotomy, he had experienced and also observed some very unfavorable results, and was reluctant to perform it, especially in patients of advanced years, notwithstanding the good results obtained by some well-known operators.

Dr. EDGAR S. THOMSON: In cases of simple glaucoma, the tension must be brought below normal to stop the cupping of the optic nerve. In chronic simple glaucoma, we should operate early and Dr. Thomson likes Elliot's operation due to the fact that the tension remains subnormal for a long time.

Dr. GEORGE H. BELL was of the opinion that many of the glaucoma patients could be benefited by investigating their focal infections and toxæmias. Nearly all of them suffer from constipation and their urine is loaded with indican, in addition to which they have bad teeth and diseased tonsils.

Recently the speaker had seen a case of **glaucoma in which a successful operation in one of the eyes had resulted in blindness.** Dr. Bell was consulted in regard to the same trouble in the other eye. He found the patient had abscessed teeth, and suffered from constipation, and feels confident that the glaucoma can be arrested by local treatment of the eye, and removal of the patient's focal infections.

Dr. BELL has a number of cases of non-congestive glaucoma which he has had under observation for from four to six years, where the fields of vision have been maintained by a treatment of hot bathing, the use of pilocarpine, and the elimination of toxæmia. In acute congestive glaucoma Dr. Bell prefers to operate in the prodromal stage, but in the noncongestive glaucoma he first attempts the treatments just outlined.

Oculists do not in his opinion pay enough attention to focal infections, food intoxication, and constipation in glaucoma cases.

DISCUSSION: Dr. M. URIBE TRONCOSO: In discussing the very important subject of glaucoma, I want to emphasize only two points; the necessity for an early diagnosis and the importance of an early treatment.

An early diagnosis can be made only if we gather a sufficient number of objective symptoms and have several opportunities for direct examination of the patient. Among the most valuable methods for the detection of prodromal stages are: tonometry, the condition of pupil and anterior chamber, and the examination of the visual field. The tonometer has certainly made diagnosis more accurate and brought to light several atypical forms of glaucoma.

For estimating the great importance of an early treatment it is necessary to understand thoroughly the pathogenic foundations of the congestive form, of which I am to speak presently. Many years ago, I advocated the theory of the retention of fluids in the eye, due to the change in the chemical composition of the aqueous and vitreous, which are transformed into colloid fluids by the pathological secretion of proteins. There are two important facts which underly the etiology of congestive glaucoma, first the sinus of the anterior chamber has been found entirely free in microscopical sections of eyes suffering from acute and hemorrhagic glaucoma. This proves that the adhesion of the root of the iris to the cornea is not essential for the production of glaucoma. The second fact is that enucleated glaucomatous eyes keep their hardness for many hours, while the normal eye softens very quickly. Such difference depends on the increased volume of the vitreous, produced by the change in the composition of its fluids, and to the closure of the angle. The change in the composition in the pathological complexus of the aqueous and vitreous constitutes the first stage only, and produce attacks of hypertension which may be temporary, according to the condition of the excretory channels; but as soon as the vitreous increases in volume by the colloid edema, the irido-lenticular diaphragm is pushed forward, the anterior chamber becomes shallow, and the angle of the anterior chamber is occluded by the root of the iris.

If in this stage we make an iridectomy, the eye will be saved, because the adhesion is only mechanical and can be destroyed easily. But if we allow this peripheral synechia to become permanent by the formation of connective tissue and the complete blocking of the pectinate ligament and Schlemm canal, the eye will be doomed and blindness shall come sooner or later.

It is of the greatest importance that ophthalmologists shall agree on this point for we must impress on the mind of the general practitioner the necessity of preventing the closure of the natural ways of excretion, instead of trying afterwards to create new and abnormal channels. This means that we ought to start a campaign similar to the one so earnestly made years ago on behalf of the early treatment of cancer, for the early surgical treatment of glaucoma.

To be truly curative, however, iridectomy must be performed in a careful and systematic way. The incision must be made 1*mm* behind the limbus. Those authors who recommend a more posterior section with the object of cutting and laying open the pectinate ligament and the Schlemm canal are entirely mistaken. Even if this result should be accomplished, it would be only transitory, as the scar tissue will close and soon obstruct these structures, defeating the very purpose we have in mind, viz.: the reëstablishment of the old angle of the anterior chamber.

The excision of the iris must be complete, to the very root of this membrane; if a stump is left this may apply itself again to the pectinate ligament and hinder filtration. Since von Graefe this rule has been emphasized, and indeed the only advantages of a scleral incision is to reach more easily the base of the iris. To obtain this end it is better to make the section with one stroke of the scissors on one side, to tear the iris to the apex and then complete the excision with another stroke of the scissors. The hemorrhage which generally comes after this iridorrhexis is only temporary. The failure of many iridectomies is only due to disregard of this rule.

When the peripheral synechia is already permanent and a new angle of the anterior chamber has been formed, the success of iridectomy is very doubtful. It certainly may diminish the intraocular tension temporarily, but as the natural ways of excretion can not be reopened, it will be necessary to resort to artificial outlets by the production of the so-called "filtering cicatrix" that is by means of the Lagrange or Elliot operations, or even by the inclusion of a piece of iris in the wound.

Dr. HOMER E. SMITH stated that he is making investigations on glaucoma, and will be glad to have made, without fee, a complete chemical analysis of the blood and urine for any member of this section, who will send such specimens to his office, together with a brief history of the case both general and ocular. Eight ounces of the 24-hour urine—noting quantity passed—blood to the amount of one ounce drawn into a clean test tube, into which has been placed ten grains of potassium oxalate. He will furnish the chemical and container to those who ask for them. Reports of the analysis will be mailed to the senders, and he will welcome with gratitude this coöperation on the part of the profession.

Dr. W. C. POSEY. I quite agree with the foregoing speaker and urge the importance of early diagnosis. I fear that even some ophthalmologists do not always make as early a diagnosis as is desirable, and believe that if they resorted to a study of the visual field for small objects as outlined by Bjerrum, Roenne, and others, and the more frequent use of the tonometer, glaucoma would be more often detected in its earlier stages. If operation could always be performed without danger, naturally one would always resort to it; but operation is not always without danger, as we all know. In advanced cases, where the field of vision is limited, what vision remains is often wiped out by operation. In cases of this type, the action of drugs is most favorable and I have seen vision retained in some instances for years by their use. In hemorrhagic cases, miotics are always of great advantage. In young cases I prefer operation, on account of the probable duration of years over which drops would have to be used. In any event, the earlier a case is put under treatment of any kind, the better.

In answer to Dr. Weeks's inquiry as to the difference between the readings of the Schiotz and McLean tonometers, Dr. McLEAN replied he is unable to explain the differences. Both tonometers are supposed to be standardized from the manometer, and yet in several series of tests with the manometers, in the presence of several members of this Society, and where they used the tonometer, the Schiotz readings failed to indicate the same pressures as the manometer. The differences on the average between the manometer and Schiotz instrument were those same differences that exist between the Schiotz and McLean tonometers.

At the suggestion of the late Dr. Marple, a McLean tonometer together with a full description of the testing apparatus and the results of the test were sent to Professor Schiotz, as Dr. Marple desired his criticism of the results obtained. After having the tonometer in his possession for several months he returned it with the word that he did not see why the results were different from his but 25*mm* must be considered the upper limit of normal tension. He failed to criticize the testing or the results of the tests, which was Dr. Marple's object in writing Professor Schiotz.

Dr. McLean had for demonstration a freshly enucleated eye which was connected to a manometer. Members of the Society were invited to test their finger sense and give an opinion as to what intraocular pressure they considered the upper limit of pressure for a normal eye. One man considered 25*mm* as the upper limit, while the highest recorded was 46*mm*. Most of the readings ranged between 36 and 42 as the upper limit of normal tension.

NOTICES.

OXFORD OPHTHALMOLOGICAL CONGRESS.

Master, SYDNEY STEPHENSON.
Deputy Master, PHILIP H. ADAMS.
Hon. Treasurer, SIR ANDERSON CRITCHETT, BART., K.C.V.O.
Hon. Secretary, BERNARD CRIDLAND, Salisbury House, Wolverhampton.
Past Master, THE LATE ROBERT W. DOYNE.

February, 1920.

PRELIMINARY NOTICE.

DEAR SIR:

The Oxford Ophthalmological Congress will assemble at Keble College, Oxford, on the evening of **Wednesday, July 14th** next, and the Meeting will be held on **Thursday, the 15th,** and **Friday, the 16th July.**

On Thursday, the 15th, a discussion on "PERIMETRIC METHODS" will take place to be opened by Dr. Luther C. Peter of Philadelphia, U. S. A.

Members intending to take part in the Discussion are requested to kindly send in their names to the Hon. Secretary at their early convenience.

The Doyne Memorial Lecture will be delivered on the morning of Friday, July 16th, by F. Richardson Cross, Esquire, J.P., LL.D., F.R.C.S., etc., the subject being "THE NERVE PATHS AND CENTERS CONCERNED WITH SIGHT."

The Official Dinner of the Congress will take place on the evening of Thursday, 15th, at Keble College.

A General Meeting will be held during the Congress at a time of which due notice will be given in the final program.

It is hoped that members will make every effort to contribute to the success of the Meeting with cases, specimens, new operations, or novelties of any kind. If, therefore, you have any such that you are willing to bring forward will you kindly notify the undersigned at the earliest opportunity and your contribution will be welcomed.

BERNARD CRIDLAND,
Hon. Secretary.

Salisbury House,
Wolverhampton.

Vol. XLIX. No. 4.

ARCHIVES OF OPHTHALMOLOGY.

SOME THEORETICAL AND PRACTICAL POINTS IN REFRACTION WORK.[1]

By ALEXANDER DUANE, M.D., New York.

IN this paper I have endeavored to bring together in succinct form some facts in physiological optics that bear on the theory of refraction as well as some practical points in the handling of refraction cases. To forestall criticism, I should add that the former part of the subject matter contains nothing that cannot be gleaned from well-known works on physiological optics (Hess, Gullstrand, and others); and that the latter part simply reiterates views that I have strongly expressed before and which long experience has convinced me to be correct.

CARDINAL POINTS.

Any clear conception of physical and physiological optics must be based on the cardinal points of Gauss. We all know that the focus of a lens system is the point where parallel incident rays meet after refraction, and probably most have a conception of the anterior focus as the point in front of a lens where parallel rays will meet if their direction is reversed. We also know that the strength of a lens is inversely proportional to its focal distance. But from what point is this focal distance to be measured? Gauss showed that, corresponding to the two foci, anterior and posterior (A and F), there are two principal points, anterior and posterior (E and I), and that the anterior focal distance is the distance between A and E and the posterior focal distance the distance between F and I. Further it was shown that no matter what the number of refracting surfaces or the character of the refracting media, the first focal distance, AE, is to the second focal distance, IF, as the index of refraction of the first medium is to the index of refraction of the last.

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[1] Read before the Section on Ophthalmology, New York Academy of Medicine, March 15, 1920.

Later investigators added to these four cardinal points of Gauss the two nodal points (K, L), distant from the principal points by an amount equal to the difference between the anterior and posterior focal distances.

It is evident that when the first medium and the last medium have the same refractive density, as in the case of a lens in air or of the crystalline lens in the eye, the anterior and posterior focal distances are equal and that consequently the nodal points coincide with the principal points.

The case is different with the eye as a whole. Here the first medium, air, has a refractive index of 1, the last medium, vitreous, has a refractive index of a little over $1\frac{1}{3}$. Hence the anterior focal distance being about 15.8*mm*, the posterior must be 15.8 x $1\frac{1}{3}$ or 21.1*mm* and the nodal points must be $21.1 - 15.8 = 5.3$*mm* behind the principal points. The principal points, in fact, are just behind the cornea, the nodal points at the posterior pole of the lens.

The principal significance of the cardinal points is shown in the following statements:

1. The position of the posterior focus with relation to the retina determines whether the eye is emmetropic, hypermetropic, or myopic.
2. The position of the posterior nodal point with relation to the retina determines the size of the retinal image and has, therefore, a bearing on the apparent size of objects and on visual acuity.
3. The main effect of glasses placed in front of the eye is not to change the refractive power of the latter but to shift the position of the cardinal points—putting the posterior focus of the eye (F) on or off the retina, and changing the position of the posterior nodal point (K) with relation to the latter.

4. If a glass is placed at the anterior focus of the eye—and this is the regular place for correcting glasses—it makes absolutely no change in the refractive power of the eye. That is, a + 10 D. lens placed 14*mm* in front of the cornea has no effect whatever on the posterior focal distance of the eye which remains 21.1*mm.* What it does do is to shift the posterior focus of the eye and also the posterior nodal point of the eye some 3*mm* forward and thus exert a marked and determinate effect on the clearness of retinal images.

5. On account of this and other properties, the anterior focus of the eye is the point where we should place glasses to be worn, where we should place the ophthalmoscope in applying the direct method, and from which we should make our measurements in determining the far point and near point of accommodation.

EFFECT OF POSTERIOR SURFACE OF CORNEA ON THE REFRACTIVE POWER OF THE EYE.

Usually in calculating the constants of the eye, the effect of the posterior surface of the cornea is neglected. It is not, however, a negligible quantity. Thus if we use the latest measurements of Tscherning in calculating the constants of the eye, we find a posterior focal distance of 20.79 if we disregard the posterior corneal surface. Using the same constants and taking the effect of the posterior corneal surface into consideration I find the posterior focal distance to be 21.14. The difference corresponds to a difference of a whole dioptry in refraction.

STANDARD EYE NOT HYPEROPIC.

I should object to the idea that the eye which has standard measurements is hyperopic instead of emmetropic. Measurements vary a good deal but those of the best observers from Helmholtz down give for the position of the posterior focus of the eye a point 22.8 to 23.9*mm* behind the cornea. The variations probably range within even wider limits than these and, so too, does the axial length of the emmetropic eye, which may be anywhere from 22 to 25*mm.* In any event, the figures do not show that regularly or often the posterior focus of the unaccommodated normal eye falls behind the retina.

RÔLE OF THE PUPIL.

The pupil as we see it through the magnifying lens formed by the cornea is about one ninth larger than the actual pupil. But this apparent pupil ("Einstrittspupille" or "inlet" pupil as Abbe calls it) measures accurately the width of the beam of rays that can find its way through the actual pupil. That is, a pupil really 4.5*mm* in diameter, and which appears to us to be 5*mm* in diameter will admit a beam of rays that occupies a circle of the cornea that is 5*mm* in diameter.

Opposed to this "inlet" pupil is the "outlet" pupil ("Austrittspupille") or image of the pupil formed by the crystalline lens. It is this figure which really forms the base of the cone of rays directed toward the retina, and determines therefore the size of diffusion images. It is, however, very little larger than the pupil itself.

CHANGE OF REFRACTION IN DEVELOPMENT OF EYE.

I think we often get a wrong conception of the change that takes place in the refractive state of the eye between infancy and adult life. We think of it, that is, as a change caused by simple elongation of the eyeball converting a primitive axial hyperopia into emmetropia and in many cases into myopia. But a moment's consideration shows that this is a very partial representation of what takes place. The infant eye is so short that, built on anything like the refractive scheme of the adult, it would have an axial hyperopia of 20 D. As in reality it is usually hyperopic only 2 or 3 D. at most—and sometimes not hyperopic at all—it is evident that in the early years of life we have a combination of two factors—an axial shortening sufficient to cause a hyperopia of 20 D. and an excess of curvature sufficient to cause a myopia of some 18 D. This excess of curvature must be located in the lens, since the cornea is not very much more curved in the infant than in the adult. As the child grows, two opposing processes occur simultaneously. The excessive curvature of the lens diminishes, causing a reduction of the curvature myopia; and the eyeball elongates, causing a reduction of the axial hyperopia. Usually, but not invariably, the latter process predominates so that the eye as a whole tends to grow less hyperopic—strives to become emmetropic or sensibly so. Under so-called civilized conditions this natural process is largely thwarted by circumstances of environment—excessive eye work and other disturbing factors.

This process of "emmetropization" has been especially emphasized by the Dutch observer Straub, who also called particular attention to its duplex character. Straub, however, as is the custom with some in Europe, grouped under emmetropia cases which here we should regard as latent hyperopia—*i.e.*, cases in which a hyperopia of a dioptry or more is habitually overcome by accommodation. Hence he was led to regard many as cases of complete emmetropization which we should not regard as such. Even so, it is rather remarkable that a process composed of two opposing and simultaneously diminishing factors should not present more variations than it does, and that there should be on the whole a steady progress toward emmetropia—even if this does often fall short of the mark or overshoot it.

ASTIGMATISM.

The researches of Gullstrand have shown that our conceptions of astigmatism must be very greatly modified. The familiar figures used in the text-books, showing Sturm's conoid and Sturm's interval and the diffusion images formed by a sphero-cylindrical surface give us only a rough idea of astigmatic refraction. This is true even of ordinary lenses and still more true of the astigmatic refraction of the eye which is a very complicated affair, indeed. Gullstrand shows that the diffusion images formed by a sphero-cylinder are not the regular ellipses and lines usually pictured, but are stellate figures. But he also points out that the shape and size of the diffusion image are not of so much consequence in determining the clearness of vision, as the way in which the light is concentrated in the diffusion image. If the main part of the light is massed in the center of the latter, the hazy area about this will be little in evidence, and we shall get a fairly distinct image. This, I may say, is evident even when we trace out the formation of images through a simple cylindrical lens by a simple mathematical analysis.

There are two points in connection with astigmatism upon which there has been some confusion.

The first concerns the astigmatism of the cornea as shown by the ophthalmometer in the central and in the peripheral areas. The use of the ophthalmometer is open to two limitations. The instrument really determines the radius of corneal curvature at the point of examination. It determines the astigmatism only by inference. That inference is based on two suppositions, first, that the refractive state of the various media behind the cornea is of a certain character; second, that there shall be no cause for the corneal astigmatism other than the unequal corneal curvature. The first supposition is violated when, without suitable correction, we apply the measurements of the ophthalmometer to the determination of astigmatism in the aphakic eye. The second is violated when in the ordinary eye we measure with the ophthalmometer corneal astigmatism at some distance from the optic axis. For in this outlying district of the cornea there is superadded to the astigmatism due to unequal corneal curvature, which the ophthalmometer shows, the astigmatism due to aberration, which the ophthalmometer does not show. I may illustrate this point as follows: If the cornea were perfectly spherical in curvature at its apex and throughout, the ophthalmometer, of course, would show no astigmatism no matter where applied. Yet, as calculations show, at 1.25*mm* from its center such a cornea would have 0.25 D. astigmatism due to aberration, and this astigmatism would increase *pari passu* as we traveled outward. This astigmatism the ophthalmometer would not reveal. On the other hand, if the cornea outside of the central area were so flattened as to do away with the astigmatism due to aberration, it would, though non-astigmatic, show an increasing corneal astigmatism by the ophthalmometer. These facts should lead us to modify any conclusions drawn from direct measurement of corneal astigmatism outside of the visual area, made with the ophthalmometer. Astigmatism, as thus measured, is sometimes greater, sometimes less than the true corneal astigmatism; and a certain amount as thus measured may really represent a compensation for astigmatism actually present.

The second point that I should like to make is this. It has been stated that astigmatism cannot be adequately corrected by a cylinder placed at the anterior focus of the eye; the reason alleged for this statement being that any glass so placed does not alter the size of the retinal image, and therefore cannot relieve the distortion caused by the astigmatism. This view I hold is incorrect. It is true that, as already stated, such a glass does not alter the refractive power of the eye. But it does shift the focus of the eye in the astigmatic meridian. Now the essence of astigmatism is that the rays in one meridian (A) are focused in a point farther back than those in meridian (B) at right angles. If by a glass we bring the focus of the rays passing through A up to the focus of those passing through B we have overcome the astigmatism and produced a clear image. Moreover, we have reduced the size of the diffusion image formed by the rays passing through A to practically normal dimensions. If the statement that I am controverting is correct, it would mean that we could not change the quasi-linear astigmatic image formed by a sphero-cylinder to a punctate image by placing a correcting cylinder at some distance in front of the glass. But this we can do. Take a + 20 D. spherical lens combined with a + 4 D. cylinder axis 90°, and form with this the image of a moderately distant point of light. The image will be more or less linear. Place at the anterior focus of this artificial astigmatic eye, namely 5*cm* in front of it, a − 5 D. cylinder, axis vertical. The linear hazy image will be reduced to one that is sharp and punctate as if formed by a spherical lens.

LENS IN ACCOMMODATION.

Gullstrand by his exhaustive analysis has shown the character of refraction through the lens when at rest and in accommodation. I will simply say here that his researches furnish further proof of the essential validity of Helmholtz's theory of accommodation, and further demonstrate that, owing to its special structure, the lens in accommodation not only changes its shape but also becomes absolutely more refractive—that is, its total index of refraction is greater in accommodation than when at rest.

He also showed that the lens consisted of a series of isoindicial refractive surfaces, *i.e.*, surfaces at all points of which the lens substance had equal indices of refraction. At the most exterior of these surfaces coincident at the poles of the lens with the exterior surface of the latter the index of refraction is 1.386. The isoindicial surface close to the center of the lens has an index of refraction of 1.404, while the very center has an index of refraction of 1.406. The isoindicial surfaces are ellipsoidal in form, the long axis of the ellipsoid being vertical. In accommodation these ellipsoids shorten vertically and spread out in a fore-and-aft direction so as to become more nearly spherical. This tendency is decidedly more marked in the central than in the peripheral isoindicial surface. In accommodation the lens increases 11 per cent. in thickness; the curvature of the anterior surface increases 87 per cent. and that of the posterior surface 12.5 per cent.

Hess and others have taught that the ciliary muscle has practically the same contractile power in childhood, youth, and middle life, so that it is able to put forth the same accommodative effort at one age as another. In this view the child of ten and the man of forty-five has each an accommodative power of, say, 15 D., the only difference being that in the child practically all this power can be exerted in expanding the lens, while in the man only a small portion of it can be so exerted, the rest being unused and latent. It would follow from this that if some agent was employed that would reduce the accommodation to 10 D., it would show its full effect in the child, whose near point would recede from 6.6 to 10*cm*, while in the man it would not be in evidence at all since all the accommodation that he needs at his eye is 4 D., and he still has 10 D. left. Even in a person of twenty, whose near point is at 10*cm*, the effect would be barely noticeable. This, in fact, is the inference that these authors make—their belief being that paralysis of accommodation, unless extreme, cannot be made out in middle life or beyond. But this is untrue. In homatropine we have an agent causing a gradually increasing, ultimately quite complete paralysis of the ciliary muscle. On Hess's theory homatropine ought to produce a noticeable effect very quickly in children, much later at the age of twenty or twenty-five, and very late, if at all, in persons over forty. But careful tests under conditions which exclude the effect caused by complicating factors (*e.g.*, the dilatation of the pupil due to the drug) show that paralysis from homatropine becomes evident almost as quickly in the older patient as in the child. I have made an extensive series of observations on this subject which seem to show this conclusively.

SOME PRACTICAL POINTS IN THE CONDUCT OF REFRACTION WORK.

On most points connected with the practice of refraction we are all agreed. On some, notably on the question of the use or non-use of cycloplegics, there is still much difference of opinion.

As a contribution to the question I should like to offer my testimony based on my life's experience in refraction work.

1. **Cycloplegia Necessary in the Determination of Refractive Errors.**—In the great majority of cases the refraction of the eye cannot be determined with certainty without the use of cycloplegics. This statement applies to astigmatism as well as to hyperopia and to both more than it does to myopia.

In making this statement I would not for a moment be understood as underestimating the necessity of making a careful test of the eye in its natural condition. This I myself invariably do and in a very large number of cases by so doing arrive at the same result as under a cycloplegic. But as I can never be sure in any given instance that this will be the case and as in some cases in which I had reason to think that the results would be the same they have turned out to be different. I feel that I must give myself and the patient the added certainty that the use of the cycloplegic affords. At the same time I feel it necessary to make the most careful precycloplegic test in order to see what the eye can do and what it will accept under natural conditions. By comparing the result with that obtained under the cycloplegic I feel that I have full data on which to base a proper judgment as to the prescription to be given.

What, in fact, are the objections urged to the use of a cycloplegic?

They are these:

(*a*) A cycloplegic is useless, since the refraction can be determined sufficiently well without it. But this is contrary to my experience. In many and many a case not only would I have failed to determine the full correction, but, what is more to the purpose, would have failed to determine the glass that gave the patient comfort, unless I had used the cycloplegic.

(*b*) The cycloplegic often fails to disclose the true refraction. But this, again, I cannot corroborate from my experience if cycloplegics are used in the proper strength and if their action is checked by the accommodation tests in the manner given below. Once in a while the tests are contradictory or unsatisfactory under homatropine. This may be because the range of accommodation remains too high. We discover this fact from our accommodation tests. In that case I use atropine. But this occurs quite exceptionally. In the great majority of cases homatropine has proved itself in my experience reliable, giving complete and satisfactory cycloplegia, although it may perhaps at times fail to disclose 0.25 D. of the hyperopia, which may be found on examination made two or three years later. But even here there is a question whether the refraction has not actually changed.

(*c*) A cycloplegic is dangerous because it may produce an acute glaucoma. This has happened to me once in my entire experience. The danger, in fact, is about as great as that of being injured in a railroad accident. We do not give up riding on a railroad because of the fear of being killed some day, if we do. Nor do we give up the use of a cycloplegic because once in ten or twenty thousand times the latter produces glaucoma.

Furthermore, an eye which develops glaucoma under a cycloplegic is an eye which is going to develop glaucoma anyhow. It is not an unmixed evil then if it develops it right before our eyes. We can usually control the increase of tension with eserine or, failing that, with a paracentesis, and then do the iridectomy that such a case should in any event have.

(*d*) We do not prescribe the glass we find under a cycloplegic, so why use this latter? By using a cycloplegic we have found the absolute static refraction of the eye. Whether we shall prescribe the glass fully correcting this or not is a question to be determined by various considerations, but at all events we have found the basic facts in the case on which to build our result by such addition or subtraction as seems proper. We might as well say, "We are not going to give a presbyopic patient his distance glass to read with; why then find his distance glass at all?" But we know that, even if we are not going to give a patient any distance glass, it is necessary to determine with accuracy and thoroughness the exact amount of error in each eye for distance, and then using this as a foundation, determine the added correction that the patient needs for near.

In determining from the cycloplegic test the glass that a patient should wear, it is important to remember that the glass which gives the best vision for fifteen or twenty feet may have to be reduced by 0.25 D. in order to give really clear vision for distance. I often, in order to determine this point, ask the patient when under a cycloplegic to look out of the window at the details of a distant object and say whether these are accentuated by the addition of -0.25 D. If so, I consider that his static refraction is measured by the glass with this addition.

2. **Use of Cycloplegics after Forty.**—Contrary to what is often stated, I have found that it is even more necessary to use a cycloplegic in middle life than in youth. Those of middle life often relax the accommodation imperfectly or with difficulty, and are often rather resistant to cycloplegics. The more flexible ciliary muscle of youth usually relaxes more readily. Personally I use cycloplegic in practically all cases up to forty-eight, and sometimes after that age.

In a paper read before the New York Academy of Medicine in 1908, I cited nineteen cases of patients between forty and forty-nine in whom homatropine had disclosed latent hyperopia of anywhere from 0.62 to 3.00 D. and latent astigmatism of from 0.25 to 1.00 D. What was particularly significant was that sometimes considerably more error was latent in one eye than in the other, so that no conceivable equal addition to the manifest correction would have given a glass satisfactory for both eyes. This point is clearly brought out in the paper cited as well as the fact that in other respects, too, a satisfactory correction would have been quite unattainable in these elderly patients without the use of a cycloplegic.

3. **Determination of Effect of Cycloplegic.**—To determine whether or not we get complete cycloplegia we should systematically employ the accommodation tests, taking the ac-

commodation before and during the instillations until the range has been reduced to below a dioptry. This is done as follows:

Suppose we have a patient with a manifest error of + 1.75 + 1.25 cyl. 90°. Putting this correction on we measure his accommodation with the Prince's rule and the accommodation line. Suppose the accommodation to be 4.5 D. We instill the cycloplegic and measure repeatedly thereafter. The accommodation sinks first to 3.5 and 3 D., then below. At this point we add a convex sphere of 1 or 2 D. to the above combination and again test the accommodation. When finally with + 3.00 added the far point is found to be at 3 and the near point at 3.75, we know that the range of accommodation is reduced to 0.75 D. and that the patient is ready for examination. This period of complete cycloplegia occurs at a time varying anywhere from forty minutes to two hours or more. Tests taken when the accommodation is not thus completely relaxed are apt to give wrong results.

We further use the accommodation test as a check to the result. If our final finding is, say, + 2.25 + 1.25 cyl. 90° then with + 5.25 + 1.25 cyl. 90°, the patient's far point should be just 3 D. If it is we feel that our test is corroborated.

4. **Precycloplegic and Postcycloplegic Tests.**—As stated, I try to make as careful as possible a precycloplegic test. In so doing I often get help from an expedient which I first learned from Dr. C. H. May. When the manifest correction in each eye has been obtained and apparently no further relaxation of the accommodation can be secured, I put on the glasses found, direct the patient to look with both eyes and then add to this binocular correction convex glasses by successive increases of + 0.25 D. Patients who have refused to take any further additions in monocular vision, may, when looking with both eyes, be led to accept as much as a dioptry or more of convex correction. The addition is made to both eyes simultaneously until blurring begins; then the effect is tried of adding to or subtracting from one glass (the patient still looking with both eyes).

When there is a large disagreement between the precycloplegic and the cycloplegic findings, I insist on a postcycloplegic test. This should be made not less than four days after the cycloplegic, since some trace of the latter often persists for this length of time, as shown by the accommodation tests, and if we make the test too soon we are likely to prescribe a glass that will be uncomfortably strong or one that will blur the distant vision. I prefer to make my postcycloplegic tests not less than a week after the cycloplegic, particularly when it is a question of giving a presbyopic glass based on the cycloplegic finding. Here we wish to be particularly careful that the full power of accommodation has returned.

5. **Necessity of Routine Accommodation Tests.**—Together with careful refractive measurement, precycloplegic, cycloplegic, and if necessary postcycloplegic, careful repeated tests should be made of the accommodation and muscles. Insufficiencies of accommodation are of great importance at all ages, though particularly in the young, and if they are not recognized and treated, the results of correction of the refraction may be disappointing. Contrary to the view expressed by Hess and others, insufficiency of accommodation is of significance and can be made out in persons of the presbyopic age.

Testing of the accommodation is of particular importance in ensuring proper presbyopic correction. Few patients of forty-eight or over will tolerate a reading glass that makes their near point closer than 3.5 D. Often, especially if they have a convergence insufficiency, a near point of 3.25 D. is the most they will bear. Others again show an unequal maximum of accommodation in the two eyes, *e.g.*, with a 2.50 addition show a near point of 3.50 D. in one and only 2.75 D. in the other. In this case often, but not invariably, we shall have to make allowance for the inequality, and give an addition of + 2.00 in one eye and + 2.25 or 2.50 in the other.

6. **Necessity of Careful Muscle Testing.**—So too, the determination of the muscle balance for far and especially for near points is of great significance in our refractive work. In the presence of a convergence excess we crowd our hyperopic correction. In the presence of a convergence insufficiency, evidenced by a marked exophoria for near and a remote convergence near point, we are careful not to give a strong presbyopic correction, which in just these cases is badly tolerated. In cases of hyperphoria we may have to add a vertical prism or in certain cases a prism paster to ensure comfortable vision. And sometimes the proper glasses can be made tolerable only after a

proper course of muscular training. Some cases can be made comfortable only by operation.

7. Factors governing the Treatment of a Refractive Error.—Treatment of our refraction cases should be based on the following considerations.

(*a*) The *age* of the patient. Obviously the younger the patient the more we can leave for his accommodation to correct. Nor must we forget that in children symptoms have not the same significance as in the adult. Oftentimes headache, asthenopia, etc., are transitory and depend on the effect on the sharply reacting nervous system of the child of various influences of which the refractive error is only one. Hence, unless there is some strong reason for giving glasses at once, I am inclined to refrain from prescribing them in the case of young children. Hyperopia of a dioptry or more and astigmatism of 0.50 D. at least may, I believe, be safely left uncorrected, the patient, however, being watched to see whether the symptoms do or do not persist under this temporizing policy. I have never had occasion to regret adopting this waiting plan, and by it have been able to save several children from the inconvenience of using glasses.

This remark, however, applies only to hyperopia. Here a temporizing plan is all the more justifiable since the hyperopia naturally tends to diminish as the child grows. But in myopia in a child I insist on the full correction at once, believing that this is the best means for preventing the increase of the nearsightedness.

(*b*) The *vision*. Patients who have sharp vision for distance and who make sharp distinctions—who can readily recognize distinctness in the strength and axis of added glasses—naturally require a particularly accurate correction. With such patients we shall be especially concerned to get the glass right to a 0.12 D., and in these a weak glass often affords a relief that we should not expect and that in other persons, less discriminating, we fail to obtain. On the other hand it is undeniable that others—and particularly those with reduced vision—often get on satisfactorily with an approximate correction. This is fortunate since in just these cases an approximate result is often all that we can get.

Certain people demand sharp vision and suffer real annoyance unless they get it. In these cases we must be particularly careful not to give an over-correction of hyperopia or an under-correction of myopia for distance. Others, particularly myopes of medium degree (4 to 8 D.), are not only satisfied with a somewhat blurred vision for distance but actually prefer it saying that the sharp definition is actually disagreeable. Again, many in office work are willing to forego sharp distant vision if they can see distinctly at a yard or two. In such it is often best to give a bifocal, in which the upper part represents the distance glass with a + 1.00 D. added and the lower the regular reading correction.

Lastly, patients with reduced vision for near will usually require a somewhat stronger reading glass than those with sharp sight.

(*c*) *Amount and Kind of Use to which Eye is Put.*—Obviously a person who is engaged in hard continuous eye work under trying conditions needs correction more than one who is not. In this regard, we must remember, first, that some forms of distant vision, *e.g.*, looking at objects in a theater, museum, or stadium, using the eyes on a train or in a motor car, etc., are more trying even than near work; second, that some forms of near work are more trying than others. Many find card-playing more taxing to the eye than either reading or writing, and, in certain forms of close work (foreign language study, proof-reading, reference work of all kinds, fine embroidery, fine draughting, etc.) the demands made on the eye are such that the most particular correction of even slight degrees of error, especially astigmatism, is required. Similarly a patient who uses the eyes much by artificial light will require a correction where he might not otherwise do so; or, if a presbyope, will require a stronger addition than he would by daylight.

In considering what is and what is not trying eye work we must remember that to children of six or eight, reading of English means what reading of a foreign language does to an adult and they may require help from glasses for what would seem to us an easy task.

(*d*) *The Symptoms and their Obvious Relation to the Use of the Eyes.*—We give glasses not because a patient has this or that refractive error, but because he has this or that symptom or because we feel assured that without glasses he is reasonably certain to develop trouble.

Again, no matter what the patient's symptoms are, we must, in prescribing glasses for their relief, be first fairly confident that the symptoms are, in part at least, either caused or aggravated by the eye condition.

In this regard we are likely to make two mistakes. First, we may consider as of ocular origin certain symptoms, such as eyeache and asthenopia, which though ocular in seat are really dependent on other causes, especially nasal obstruction or dental infection. I have repeatedly seen instances where correction of these extraocular conditions relieved symptoms which were apparently due to eye trouble and which were certainly induced by the use of the eyes. But while we should not fall into the mistake of regarding all eye symptoms as necessarily due to the eyes, we must equally avoid the opposite mistake of failing to recognize the influence of refractive, accommodative, and muscular errors of the eyes in causing all sorts of symptoms, some of them not apparently ocular. We must remember that an asthenopia of nasal origin will regularly be aggravated by the use of the eyes and will require help from glasses as well as nasal treatment. It is the mark of the skilled ophthalmologist as distinguished from the mere refractionist that he is able to discern the relative importance of all the factors, extraocular as well as ocular, and in some measure assign to each its probable effect.

We must also bear in mind the considerable difference between individuals with regard to their reaction to strain of any kind. Some seem to be able to stand all kind of stresses; others suffer intensely from slight abnormalities and their consequences. The latter sort of patients we must correct with extreme care and patience. Nor should we too lightly dismiss complaints that seem to us querulous and ill-founded. Slight blurring of vision, almost indefinable symptoms of discomfort, annoyances arising from maladjustment—difficulties which seem to us very trivial—may in sensitive individuals produce what is to them intolerable annoyance. These troubles are more real than we are apt to think. Patient attention to them and their correction and extreme care in the selection, adjustment, and verification of glasses are required and should be given.

(*e*) *The Accommodation* and (*f*) *Associated Muscular Conditions of the Eyes.*—As already stated careful attention should be paid to these points in every routine examination of the refraction, and proper steps should be taken to correct any outstanding defects which are giving symptoms. With regard to this point it may be said that it is often difficult in the presence of a muscular anomaly to tell whether this or the refractive error is the cause of the symptoms. In this case the refractive error should be corrected first, and after a reasonable interval given to ascertain what this alone will accomplish, measures should be taken to relieve if necessary the effects of the motor anomaly.

(*g*) *The Associated General Symptoms and General Condition of the Patient.*—The influence of the patient's general condition on his ability to do eye work is obvious. A patient depressed by overwork or in other ways may develop eye symptoms, the relief of which may require both treatment addressed directly to the eyes and treatment designed to remove the cause of the systemic trouble. Patients who are mentally depressed or mentally backward and patients who are nervous or supersensitive require special care in examination and special attention in treatment. The relief of their eye condition may be an essential element in their improvement and we must give our best efforts to secure good results in this regard. At the same time in our zeal to correct the eyes we must not forget the individual and his idiosyncrasies nor the fact that the correction of his other physical and his nervous ailments claim equal attention with the ocular treatment.

To give the patient the best service we may have to forego for a time the treatment of the eyes and call in the aid of other specialists or of a general practitioner.

I think the whole matter of handling refraction cases may be summed up in these two maxims:

First, let us find out all we can about the eyes we are treating and the symptoms of which they are a part; using to this end every means that experience has proved to be helpful, never doing the work in a hurry, and remembering always that this work of all others requires patience, thoroughness, and accuracy.

Second, let us constantly bear in mind the fact that we are treating patients, not eyes; we are handling human beings, not machines; and that we cannot do our best work unless in each case we put ourselves in touch with the individual man before us, showing sympathy for his troubles, consideration for his infirmities, and an understanding mind to take in all the physical and mental factors which may affect his outlook on life and determine his need for refractive or other correction.

AFFECTIONS OF THE EYE FROM DISEASED TEETH IN THEIR RELATION TO THE LYMPHATIC SYSTEM.

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RELATIONS between certain affections of the eye and diseased teeth have been recognized since the remotest ages, but only in relatively recent years have such views received the necessary scientific foundation through clinical and anatomical investigations. Although the number of reliable reports of actually observed transmissions of pathological processes from the teeth to the eye is not inconsiderable, little is yet known concerning the routes of transmission that could in any way be considered as positive and final. Probably all these transmitted processes are of a bacterial and bacteriotoxic nature. The dental origin of cases of the so-called dental eye fistula, orbital phlegmon, and abscesses is revealed chiefly through the fact that the eye conditions either promptly disappeared with treatment of the involved teeth, or that they developed upon the extraction of a tooth, with or without involvement of the maxillary sinus. The traveling of the pus from diseased teeth to the orbit, as for example in phlegmon, has often been represented as being *per continuitatem* along the outer surface of the maxilla over the orbital border. Frequently a transmission by way of the veins is assumed and also a few casual suggestions occur in the literature that the processes may progress by way of the lymphatics. The latter view, however, has received very little attention.

In his chapter on the interrelationship of eye and teeth conditions, Misch (1) makes the remark that a propagation by way of the lymphatics would always have to follow a roundabout course through the preauricular lymph glands. Hence, no certain case of a development in this way has yet been demonstrated. "It is true," he states, "that Birch-Hirschfeld (2) found a system of spaces in the orbital tissue, which is probably to be regarded as a lymph space system, but a communication of the lymph vessels of the orbit with those of the antrum of Highmore or the other accessory sinuses has so far not been demonstrated anatomically." The few hints in the literature, of a propagation along the lymph vessels may nevertheless be mentioned. In his report of orbital phlegmon Hirsch (3) describes four cases due to diseased teeth and expresses the view that in these cases the infecting agents from the infected peridental tissue were transmitted from the soft parts of the upper jaw to the orbit by way of the blood or lymph vessels. In further explaining, however, the process of propagation he only discusses a mode of transmission by the veins. Equally brief are remarks by Hillemanns (4) concerning the spreading of the process in his two cases of central retinitis arising from a diseased tooth to the root: "in both cases it was undoubtedly an inflammation extending from an inflamed tooth root to the posterior ocular pole by way of the lymph vessels or through the veins *per continuitatem.*" No further comment upon the transmission by the former route is made by Hillemanns. Borel (5) simply states that the microbes and toxines from carious teeth are carried with the blood and lymph stream to the eyes. Mayrhofer (6) concludes from the anatomical study of his three cases that besides bony canals which have been described by Parinaud, the blood and lymph paths of the soft parts must be considered as probable routes of transmission. In his cases he found the fistulous duct embedded exclusively in the soft tissues. More positive is Pagenstecher's (7) statement that an inflammation of the orbital tissue may undoubtedly result from diseased teeth through direct infection, "which in all probability is transmitted through the lymph vessels."

Vossius (8) assumes in his case a rapidly ascending phlebitis, respectivelylymphangitis. Gutmann (9) remarks concerning the pathogenesis of one of his reported cases of orbital phlegmon due to infections from teeth: "Abscesses had developed in the orbit and the corresponding frontal sinus from the tooth alveolus by way of the lymphatics." He arrives at this conclusion from his microscopical findings. The route of transmission assumed in the other two cases is not the same. Generally such clear assertion that it was one or the other route is lacking. Not rarely the propagation by the vein is assumed, in spite of the distinct statement that indications of an actual phlebitis were not observed.

While these statements merely hint at the possibility that lymph vessels may carry infections from the teeth to the orbit, there is a positive reluctance on the part of authors to assign these channels any rôle in the extension of septic processes from the eye to the optic nerve and the meninges. This is particularly noticeable in Birsch-Hirschfeld who demonstrated a system of lymph spaces in the orbital tissue. This author as well as Merkel and Kallius (10) has also called attention to the interesting fact that the arteries are very loosely embedded in the orbital fatty tissue and that this is very probably due to the presence of perivascular lymph channels. Birsch-Hirschfeld makes the distinct statement that the distribution and the communications of lymph spaces which he found in this tissue are such as to provide definite channels for the propagation of inflammatory processes, and he adds: "Through the study of numerous microscopical preparations from a case of orbital phlegmon I have convinced myself that these spaces serve as routes for the invading leucocytes and lymphocytes." Yet he assumes a thrombophlebitis or a phlebitis or a periphlebitis in practically all cases where infections are transmitted from the orbit to the meninges and he even is an opponent to the belief of other authors that the processes may spread along the nerve sheaths. It would seem that it is not entirely consistent to admit a transmission of infections from the teeth to the eye by way of the lymphatics as well as a spreading of the processes in the orbit through the lymph spaces, while he interprets any further propagation from this region to the brain, without exception, as a phlebitis. It is only reasonable to assume that the lymph channels of the orbit as elsewhere in the body communicate with those of the neighboring regions and that lymph vessels accompany the blood vessels and nerves through the orbital fissures and foramina and even the minute openings through the bone. Of interest in this connection are observations by Oeller (11), Leyden (12), and others of transmissions of infections along the nerve sheaths.

If we thoroughly study the anatomy and histology of the structures involved in these cases we will undoubtedly concede that the lymph vessels may play a primary and chief part. The veins may often be only indirectly the route of propagation. Gurwitsch (13) and others have demonstrated that the veins communicate with one another much more freely than the arteries and these communications are of special practical significance as Wetzel (14) has shown, for the reason that there are lymph spaces and lymph vessels in and about the walls of the veins, the course of which follows that of the veins. He calls attention to the fact from histology, that the tissue elements of the wall of the veins follow chiefly a longitudinal direction. This, of course, involves also an arrangement of the lymph spaces in a longitudinal direction. Inflammations and septic processes therefore progress preferably along the veins. They follow the lymph channels in the first instance; from the lymph spaces they spread in the adventitia, get access into the media, and finally invade the intima and thence spread in the rapidly forming thrombi. According to Benda (15) this course of phlebitis, in general, corresponds exactly to the picture of a localized phlegmon.

Mention must be made of an interesting observation made by Lartschneider (16 and 17) which refers to abscesses of the medullary spaces of the maxilla arising from diseased teeth and breaking through externally as fistula at the corner of the eye. The chief teeth concerned in these cases are the lateral incisors and the canines. Pus from diseased teeth may travel upwards under the periosteum of the anterior surface of the maxilla and reach the orbit *per continuitatem*, for the periosteum is directly continuous from the inner surface and border of the alveoli to the inferior and lateral walls of the orbit. Rupture of alveolar abscesses of the lateral incisor, labially and backwards, however, is not easy; they rather tend to break through upwards into the spongiosa and produce large abscesses of the bone, which Lartschneider has called "Markhöhlenabscesse," abscesses of the medullary spaces. They may remain latent for years before breaking through externally. The diagnosis of such abscesses is difficult because neither swelling nor fluctuation is observed in them; but it is supported, according to Lartschneider, by the occurrence of swollen lymph tracts in the apical region of the involved lateral incisor at the plica of the mucosa. He warns, however, against mistaking mucus glands in the submucosa for enlarged lymph vessels. Of interest also are statements by Parinaud (18) concerning inflammations of the lacrimal sac in children. Contrary to the general view that inflammations from diseased teeth travel *per continuitatem* on the outer surface of the maxilla to the eye, he believes that pus from the infected tooth in his cases had traveled through canals into the substance of the jawbone and thence passed out into the skin through a fine opening in front of the lacrimal canal. The route which the pus takes in children in such cases is one provided for in the development of the teeth. That is to say, there are minute canals from the alveoli of the temporary teeth communicating with those of the second set of teeth and these latter are at a certain time so embedded in the anterior wall of the maxilla that the upper portion reaches the inferior orbital wall. Parinaud demonstrated the presence of these canals by injection of fluids.

Because these suggestions of a direct communication by lymph channels between the dental and the eye regions are, from the anatomical standpoint, quite vague and incidental, further investigations of this question seem indicated.

Demonstration of these communications by injection of the lymph vessels by the Gerota method such as has been successfully done with those of the dental pulp and the peridental tissue (19, 20, and 21) is almost impossible. The pressure must be considerable in order to force the injection fluid through the minute openings of the bone into the peridental tissue; the injection is followed by massage. If the pressure is not sufficient the fluid will not be driven far enough. I have, however, sometimes succeeded in filling deep and superficial lymph vessels of the infraorbital region of the face, simultaneously with those of the dental region. It is also obvious that injections in the region of the eye are unsuitable for such purposes; the injection mass will follow the direction of the least resistance and fill the loose tissue of the orbit. This occurs also in injecting the fluid through the infraorbital foramen, which is the most accessible place to the eye as well as the dental region for reaching lymph channels in either direction.

In further experimental attempts to approach the question of anatomical relations between these two regions I followed the precedents of such writers as Orr (22), D'Abundo (23), and especially Homen (24). These investigators have shown that bacteria or their toxins experimentally or pathologically introduced into peripheral nerves are carried along the endoneural and perineural lymph channels to the spinal cord and brain and are capable of producing lesions in regions of the central nervous system quite remote from the seat of the original infection. With a similar point in view I have injected bacteria (staphylococcus, streptococcus, bacillus pyocyanus and haybacillus) into nerves of the face, into some of the lymph glands of the face, and into the subarachnoid space of rabbits. In some cases propagation of the bacteria from the place of injection, presumably along the nerve sheaths to remoter regions and occasionally even to the pulp of teeth, could be observed. However, the crucial point, to demonstrate beyond any doubt an exclusively lymphatic transmission by the presence of bacteria in genuine lymph channels lined with endothelial cells, is not easily settled to one's own satisfaction. Unless the bacteria are so numerous that they fill the lymph vessels to their capacity the delicate walls collapse.

Several of these animals were treated with vital staining fluids (trypan blue and lithium carmine) before being injected with bacteria. Observations in previous work on vital staining (25) led me to believe and express the view that the vitally stained granular cells in the connective tissue of all organs are intimately related to the lymph system. Possibly they are the endothelial cells lining the lymph channels at the very origin of the lymph system, having the property and function of absorbing the fluid from the tissue spaces and clefts as lymph proper. Lymph vessels which simply conduct the collected lymph to other lymph vessels, to lymph glands and venous outlets, are not lined with cells capable of taking the vital stain. With the extensive anastomoses existing in the lymph system it is possible to assume that bacteria injected into the tissue in the manner of the Gerota method might under favorable conditions find their way into these primary lymph spaces and lymph capillaries whose true essential character as lymph channels is indicated by the vital staining of their endothelial cells.

I finally limited my efforts to an experimental study of the lymph supply of the eye only, making use of vital staining and of a drug by means of which Birch-Hirschfeld believes to have demonstrated lymph spaces and lymph vessels in the orbital tissue. This drug is paraphenylendiamine hydrochloride, the action of which is, according to this author, to cause dilatation of the capillaries and increase of the lymph excretion; and this is especially well demonstrated about the eye.

The results of my experiments are described in detail in a paper entitled, "A Contribution to the Study of the Lymphatic System of the Eye," which is being published in *The Anatomical Record*. The main observations may be briefly summarized here.

Experiments with vital staining, carried on for years, have led me to the conviction that the vitally staining cells which are found in the connective tissue of practically all organs of the body are intimately related to the lymph system. These cells have received various names, rhagiocrines, resting wandering cells, macrophages, pyrrol cells, histiogenic cells, etc., and their functional character has been variously interpreted; they are generally alleged to have secretory functions. The constancy with which these cells occur in the same tissues and organs, their systematic arrangement and distribution, their relation to the blood vessels, have led me to believe that they are the endothelial cells lining the minute lymph channels which constitute the beginning of the lymph system. The ability of the cells to take up the vital stain probably coincides with specific functional activities on their part, one of which may be to collect the modified plasma of the surrounding tissue as lymph proper. Lymph vessels which merely conduct the lymph have not vitally staining endothelial cells. The application of this presumed relationship of the vitally stained cells to the lymph system does not lead us to any conflict with anatomical data. Assuming that vitally stained cells in the connective tissue denote the presence of lymph channels we are struck by the constantly recurring observation that these cells are only found where lymph vessels are known to be present or where they may be presumed to exist; they are invariably absent in those tissues which are known or suspected to be devoid of lymph vessels. I may mention here that Schnaudigl (26) who studied the effect of vital staining on the eye made observations concerning the occurrence of vitally stained cells which are on the whole in accordance with my own. He did not, however, draw any inferences as to their possible relationship to the lymph system.

The lens is devoid of vitally staining cells. No such cells are found in the cornea; but the conjunctival tissue overlying the corneal tissue shows such cells in large number. Occasionally a long slender vitally stained cell is seen to extend from the conjunctiva into the cornea. As to the sclera which contains such cells in scant number, it is not quite clear whether they belong to the tissue proper or whether they accompany the vessels traversing the scleral tissue. The cells are quite numerous in the scleral and corneal conjunctiva and are present in great abundance in the limbus conjunctivæ. The iris is very poorly provided with them; a cell is found here and there in the region towards the posterior chamber. This scarcity is the more striking as the organ, which it joins, is unusually rich in vitally staining cells, namely the ciliary body, and chiefly the ciliary processes. The cells are in proportion more plentiful here than in any other part of the eye. They are arranged along the blood vessels, from which, however, they are always at some distance. They are present in all processes, they are always in abundance and they are always arranged in the same way. When the injections of the staining fluid have been continued for some time these cells are very large and the granules are very coarse while in the iris or the sclera they remain small and slender, an observation to which also Schnaudigl has called the attention. This author believes that these cells have an almost dangerous affinity for the staining substance; they are very vulnerable and show the injurious effect of the dye after prolonged contact with the staining fluid. From the root of the ciliary processes the cells are observed to occur in smaller number all along the subjacent inner layer of the ciliary body; the deeper region facing the sclera, is scantily supplied with these cells and resembles the iris in this respect. In the choroid the cells are found chiefly in the choriocapillaris. There are none in the retina. The endo- and perineural tissue always contains vitally stained cells. The loose orbital tissue is relatively poorly supplied with them. The muscles of the eye show the cells in the interfascicular and interfibrillar tissue, generally in the neighborhood of the blood vessels. They seem to be in closer relationship to the blood capillaries than is for example observed in the ciliary processes; they often seem to spin around the capillaries while these again wind about the muscle fibers. In the lacrimal gland they occur in the interacinous tissue and the connective tissue surrounding the glandular structures. The lids and the nictitating membrane are well supplied with them; they always occur in the same arrangement and the same distribution. The cartilage is absolutely free from such cells.

If we are to admit the view that these cells represent the endothelium of lymph capillaries and lymph spaces, we recognize that these findings correspond quite well with what we actually know or may reasonably presume concerning the lymph supply of the different parts of the eye.

Birch-Hirschfeld believes he has demonstrated a lymphatic apparatus of the orbit by means of paraphenylendiamine the effect of which in the dog and the rabbit is edema of the orbital tissue. I am not inclined to consider all the innumerable spaces which we find filled with fluid after diamine poisoning as dilated lymph spaces and lymph vessels. The fluid does not only fill all available spaces but also splits apart the fibers of muscles and the connective tissue. One of the chief effects of the drug seems to be on the blood vessels, perhaps irritating the endothelial wall of the capillaries and thereby rendering it more permeable. This is particularly noticeable in the muscles of the eye. Puppe (27) and Kunkel (28) also assign to the blood vessels a greater significance for the development of the intoxication edema.

On account of the extensive anastomoses of lymph vessels obstruction to the outflow of lymph does not readily occur. We may conceive of the action of paraphenylendiamine as such: in subcutaneous injections the drug enters the lymph channels; thence it is carried into the blood, where it irritates the walls of the blood vessels possibly having an injurious effect on the endothelial cells of the capillaries. Transudation of the plasma occurs very rapidly, the fluid filling all the tissue spaces and separating the tissue elements. The function of the endothelial cells of the lymph capillaries being not simply one of absorption of such free fluid, but probably one of a selective action, of an interaction of metabolic processes, the fluid is not taken up and carried off rapidly enough with the result that stasis-edema develops. The value of paraphenylendiamine in conjunction with vital staining is in my opinion this, that it illustrates and supports the theory of a difference between spaces filled with tissue fluids and real lymph spaces and lymph capillaries, which constitute the channels of origin of the lymph system.

It has become customary to consider the ciliary body as the main source of the intraocular fluid. Hamburger (29) attributes also to the iris an important rôle in the function; in fact, he believes that every part of the eye participates in the secretion and resorption of the fluid. Wessely (30) is of the opinion that it comes nearest a transudate. It does not contain any substance which is foreign to blood serum. There is, hence, no reason why we should not consider the process of its secretion as a filtration process. Some difficulties arise from the relatively high salt content and the involved greater osmotic pressure, a property which it shares with the lymph. The most striking difference is no doubt the low albumen content which places it in one class with the cerebrospinal fluid, the anniotic fluid and the urine excreted in the glomeruli of the kidney, and on the other hand makes it stand in marked contrast to the lymph. Counterpressure to transudation may be the explanation; but we are quite as well justified in supposing that the presence of a special layer which covers the vessels may be the cause of the retention of the albumen. In the eye, the epithelium of the ciliary processes and the endothelium of the iris may act as such barriers.

Schnaudigl expresses the view that the vitally staining granular cells in the connective tissue of the ciliary bodies may be the chief agents in the secretion of the intraocular fluid. The epithelial cells covering the ciliary processes remain colorless in injections of trypan blue, an observation which I also made with lithium carmine. It does not seem permissible to me to assume this specific function from the mere fact that these cells have a pronounced affinity for stains. For we must bear in mind that not only do vitally staining cells practically occur throughout the body in the connective tissue but also that invariably they are larger and more coarsely granular in definite regions of the body, for example in the pia of the brain where they occur in patches, in the choroid plexus, in certain regions of the nasal apparatus. On the other hand, there are cells admittedly endowed with secretory functions, cells other than those within the connective tissue which also have a pronounced affinity for vital stains (the epithelial cells of the choroid plexus, in the hypophysis, the thyroid gland, the syncytial cells of the placenta, the epithelial cells of the convoluted tubules of the kidney) while other cells of a similar type are not stained by trypan blue or carmine. I am more inclined to believe that inasmuch as these particular vitally staining cells occur practically everywhere in the connective tissue they have everywhere the same function to perform and inasmuch as in some localities they are invariably more intensely stained, they are involved either more intensely in the same process, or in another associated function. Along this line of reasoning we may also assume that the function of lymph secretion or lymph resorption is associated with the secretion of a fluid related to lymph such as the cerebrospinal fluid, the intraocular fluid or even the chyle. From this standpoint the great scarcity and smaller size of vitally staining cells in the iris would speak against the view of some writers that the iris is notably involved in the secretion of the aqueous humor while the presence of a large number of intensely staining granular cells in the ciliary body support the more generally accepted theory that these cells are the main source of the intraocular fluid. On the other hand there is nothing in my view of the part which the vitally staining cells play in the lymphatic apparatus that would contradict the view expressed by Hamburger that there is a more active resorption of the fluid by the iris through lymph channels than the generally assumed venous drainage into the canal of Schlemm. The fluid has a direct entrance into the iris through the crypts and thence into the lymph vessels. According to my observation lymph channels which simply convey lymph have no vitally staining endothelial cells. This might explain the curious fact that there are so few of such cells in the iris, especially in the anterior portion. As to the drainage into the canal of Schlemm, Hamburger states that the resorption through the spaces of Fontana may also be along perivascular lymph spaces and not by the blood vessels.

Since indubitable evidences of an etiological relationship between infectious processes about the teeth and pathological conditions elsewhere in the body have been the indices for new therapeutical measures, any clinical and anatomical contribution must be considered as an aid or a stimulation to further investigative work. As such I offer these data from the literature and the mere suggestions of experimental observations along these lines. Affections of the eye from diseased teeth in their relations to the lymph system represent a field which still is practically unexplored.

LITERATURE.

1. Misch, J. *Lehrbuch der Grenzgebiete der Medizin und Zahnheilkunde*, Stuttgart, 1914, 854.
2. Birch-Hirschfeld, A. "Die Krankheiten der Orbita," *Graefe-Saemisch Handbuch der gesamten Augenheilkunde*, 1919, 167–170 Lieferung, p. 261.
3. Hirsch, C. "Ueber Orbitalphlegmone," *Prag. med. Wchschr.*, 1894, xix., 182, 193, 207.
4. Hillemanns, M. "Ueber Sehprüfung bei künstlicher Beleuchtung. Lichtsinusstörung besonders bei Myopie," *Klin. Monatsbl. f. Augenheilk.*, 1909, xlvii., II Teil, 304.
5. Borell, M. "Relations entre les maladies des yeux et les maladies des dents," *Schweiz. Vierteljs. f. Zahnheilk.*, 1908, xviii., 188.
6. Mayrhofer, B. "Die dentale Augenwinkelfistel," *Oesterr. ung. Viertelj. f. Zahnheilk.*, 1907, xxiii., 6.
7. Pagenstecher, H. "Beiträge zur Aetiologie und Therapie der Retrobulbären Zellgewebsentzündung," *Arch. f. Augenheilk.*, 1883–84, xiii., 138.
8. Vossius, A. "Klinische Mitteilungen. Ein Fall von Orbitalphlegmone bei Orbitalvenen nach Extraction eines kariösen Backzahnes mit Ausgang in Heilung und Erhaltung des Bulbus, sowie des Sehvermögens," *Graefe's Arch. f. Ophth.*, 1884, xxx., Part 3, 157.
9. Gutmann, A. "Erkrankungen des Orbitalinhaltes nach Zahnextraktionen," *Centralb. f. Augenheilk.*, 1912, xxxvi., 77.
10. Merkel and Kallius. "Makroskopische Anatomie des Auges,"

Graefe-Saemisch Handbuch der gesamten Augenheilkunde, 1900, II. Aufl., Kap. I., p. 153.

11. OELLER. "Orbitalphlegmone und Sehnervenatrophie," *Festschrift z. 80. Geburtstage vom Prinzregenten Luitpold*, 1902.
12. LEYDEN, E. "Chemosis conjunctivae als Symptom einer eitrigen Meningitis," *Virch. Arch.*, 1864, xxix., 199.
13. GURWITSCH, M. "Ueber die Anastomosen zwischen Gesichts- und Orbitalvenen," *Arch. f. Ophthalm.*, 1883, xxix., 4 and 31.
14. WETZEL, C. *Lehrbuch der Anatomie für Zahnärzte*, Jena, 1914.
15. BENDA, C. Aschoff's *Pathologische Anatomie*, Jena, 1913, ii., 90.
16. LARTSCHNEIDER, J. "Beiträge zur Anatomie und Chirurgie der von oberen Frontzähnen ausgehenden Kiefererkrankungen," *Oesterr. ung. Viertelj. f. Zahnheilk.*, 1907, xxiii., 345.
17. LARTSCHNEIDER, J. "Studien über pathologische Anatomie und Therapie der Wurzelerkrankungen mit Berücksichtigung der Trikresol-Formalinbehandlung," *Oesterr. ung. Viertelj. f. Zahnheilk.*, 1907, xxiii., 146.
18. PARINAUD. "Des suppurations de la maxillaire inférieure et de la région du sac lacrymal d'origine dentaire," *Archiv. génér. de Méd.*, 1880, v., 667.
19. DEWEY, KAETHE, AND NOYES, F. B. "A Study of the Lymphatic Vessels of the Dental Pulp," *Dental Cosmos*, 1917, lviii., 436.
20. NOYES, F. B., AND DEWEY, KAETHE. "The Lymphatics of the Dental Region," *Jour. Am. Med. Ass.*, 1918, lxxi., 1179.
21. SCHWEITZER, G. "Ueber die Lymphgefässe des Zahnfleisches und der Zähne beim Menschen und bei Säugetieren," *Arch. f. mikrosk. Anat. u. Entwickl.*, 1907, lxix., 807; *ibid.*, 1909, lxxiv., 927.
22. ORR, W. H. "A Contribution to our Knowledge of the Course of the Lymph-stream in the Spinal Roots and Cord." *Rev. Neurol. and Pyschiatr.*, Edinburgh, 1903, i., 639.
23. D'ABUNDO, G. "Sulle Vie Linfatiche del Sistema Nervosa Centrale," *Annali di Nevrologia*, 1896, xiv., 229.
24. HOMEN, E. A. "Die Wirkung einiger anaeroben Bakterien namentlich bei Symbiose mit aeroben Bakterien, sowie ihrer Toxine auf periphere Nerven, Spinalganglien und das Rückenmark," *Arbeiten aus d. path. Instit. d. Univ. z. Helsingfors*, 1905, I., i.
25. DEWEY, KAETHE, "A Contribution to the Study of the Pathways of the Cerebrospinal Fluid and the Choroid Plexus," *Anat. Record*, 1918, xv., 1.
26. SCHNAUDIGL, O. "Die vitale Färbung mit Trypanblau am Auge," *Arch. f. Ophthalm.*, 1913, lxxxvi., 93.
27. PUPPE, G. "Ueber Paraphenylendiamin Vergiftung," *Vierteljahrsschr. f. gerichtl. Med.*, 1896, 3 Folge, Bd. xii., Supplementheft, p. 116 (quoted by Matsumoto).
28. KUNKEL, A. J. *Handbuch der Toxikologie.* Jena, 1901, p. 616.
29. HAMBURGER, C. *Ueber die Ernährung des Auges.* Leipzig, 1914.
30. WESSELY, K. "Der Flüssigkeits- und Stoffwechsel des Auges mit besonderer Berücksichtigung seiner Beziehungen zu allgemein-

physiologischen und biologischen Fragen." *Erg. d. Phys.*, Wiesb., 1905, iv, 565.

"Experimentelle Untersuchungen über den Augendruck, sowie über qualitative und quantitative Beeinflussung des intraokularen Flüssigkeitswechsels." *Arch. f. Augenheilk.*, 1908, lx., 97.

TENOTOMY OF THE INFERIOR OBLIQUE.[1]

By HARVEY J. HOWARD, M.A., M.D., Peking, China.

(*With four photographs on Text-Plate XIV.*)

THE diagnosing of motor anomalies of the eyes is receiving more serious attention on the part of ophthalmologists than ever before. It is now recognized that about one in every three or four eye patients that come to one's private office suffer from some defect in their eye movements. These patients generally come with a history of symptoms of asthenopia which they hope to relieve by the wearing of glasses. It is easy to overlook a pathologic muscle condition unless a fairly complete muscle examination is routinely made. When overlooked, it is quite possible that the glasses prescribed to correct ametropia actually aggravate the symptoms which in many cases are almost entirely due to a muscle imbalance.

Only a small proportion of muscle cases can be dismissed with simply the prescribing of glasses. Many of them are bound to tax the skill and patience of the ophthalmologist and require careful observation and various forms of treatment over more or less extended periods. Now and then a case is found, generally one of long standing, which is not amenable to treatment of any kind. Likewise the effect of corrective measures varies so greatly with different individuals that one must always give a guarded prognosis as to a complete cure. In many cases the patience of the patient is exhausted before the ophthalmologist exhausts his repertoire of treatment.

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These cases obviously add nothing either to the good reputation or the comfort of mind of the doctor. It has been the experience of many men that once they tackled the study of eye muscles and eye movements in the same determined and intelligent way in which they tackled their primary medical education most of the mysteries of muscle cases cleared up, and the new enthusiasm which they had for such cases gave them a new hold on their patients.

To diagnose cases of simple latent lateral deviations is comparatively easy. A knowledge of the principles of muscle movements permits us, for example, to differentiate between a convergence insufficiency and a divergence excess; or between a primary convergence excess and a secondary divergence insufficiency on the one hand, and a primary divergence insufficiency and a secondary convergence excess on the other hand. It is when we are confronted with high degrees of hypertropia or hyperphoria that we find complete diagnosis more difficult. In long-standing cases especially of the acquired type we are apt to find that other motor anomalies have taken place, which have altered the original condition from a simple to a very complicated one. However, even in these cases, our task is made easier if we keep clearly in mind the normal physiological action of the eye muscles, both individually and collectively.

One of the most striking anomalies of an individual muscle is underaction of a superior rectus. This underaction is generally caused by some impairment of the nerve branch or the nerve nucleus supplying that muscle, in which case we speak of the deviation as paretic. Underaction may also be caused by an ill-development of the muscle itself, or by some fault in its origin or insertion, in which case the anomaly is called, according to Duane, a structural or an insertional deviation respectively. Underaction of a superior rectus muscle may be congenital or acquired. If congenital, the deviation is apt to remain noncomitant and for this reason gives as a rule the most typical picture. If acquired, the deviation always tends to become comitant, *i.e.*, by a gradual contraction of the direct antagonist, which in the case of the superior rectus would be the depressors of the same eye, the eye affected is made to stand lower than the other in all the fields of fixation. This enables the individual to more readily suppress the false image which becomes less and less annoying as time goes by. Sometimes a head tilting is brought about, in order either to compensate for the lower position and consequently the higher image of one eye, or to more readily effect a suppression of the false image.

Recently a number of these cases have been published as having been treated with either total or partial relief of symptoms by tenotomy of the inferior oblique of the opposite eye. This muscle is the associated antagonist of the superior rectus of the other eye, which means that these muscles as a pair perform a coördinated or an associated movement of the two eyes —a movement evidently controlled by a common center in the brain. So comparatively few cases of tenotomy of the inferior oblique have been published with full reports that there is only a small amount of data on hand as to what degree of correction of a deviation in a vertical plane we may expect from such tenotomy. It is therefore for the purpose of making a small contribution to this subject that I desire to report somewhat in full two cases which recently came under my care and observation.

CASE I.—S. C., age 9, son of a missionary. History of "crossed eye" for several years. Father thinks boy may have had it since birth, but not sure. Seems stupid in his school work.

Vision without correction: R. = $\frac{20}{30}$ – 2; L. = $\frac{20}{30}$ – 3.

Vision with the following correction which has been worn for the past three or four years: R. + 1.00 sphere, + 0.75 cyl. @ 90° = $\frac{20}{30}$ + 2; L. + 1.25 sphere, + 0.75 cyl. @ 90° = $\frac{20}{30}$ + 2.

A. Tests without glasses showed:

I. With screen and parallax.

1. Esotropia for distance of 12^{Δ} and for near of 16^{Δ}. The esotropia was generally manifested by the left eye although fixation with the left eye could be maintained for a brief period (Fig. 1).

2. Right hypertropia with the left eye fixing of 30^{Δ} and a left hypotropia with the right eye fixing of 20^{Δ}.

3. A 25^{Δ} prism vertically placed before one eye and a red glass before the other brought the two images on a horizontal line. There was, therefore, an anatropia of 5^{Δ}, for the 25^{Δ} prism undercorrected the right hypertropia by 5^{Δ} and overcorrected the left hypotropia by the same amount. This phenomenon was demonstrated by the screen and

parallax test first before one eye and then the other while the prism was in position, when it was found that the eyes came down an amount equal to 5^{Δ} in each case when the screen was removed.

II. Using a straight line on a card rather than a small object like a pin's head, the relative near point of convergence was found to be 75*mm* which was calculated from the center of rotation of the eyeball. The convergence angle was 39°.

III. Testing the associated movements of the two eyes showed:

1. Marked underaction of the left superior rectus and overaction of the right inferior oblique, both elicited by the position of the eyes when the patient looked up and to the left (Fig. 2).

2. Underaction of the right inferior rectus and overaction of the left superior oblique, both elicited by the position of the eyes when the patient looked down and to the right.

3. Other associated movements normal.

IV. With the Worth-Black Amblyoscope the extent of the eye movements was recorded as follows:

Eyes to the right..........	right	eye	50°,	left	eye	45°.
Eyes to the left...........	“	“	52°,	“	“	45°.
Eyes up and to the right..	“	“	37°,	“	“	35°.
Eyes down and to the right	“	“	23°,	“	“	40°.
Eyes up and to the left	“	“	40°,	“	“	5°.
Eyes down and to the left	“	“	30°,	“	“	25°.
Eyes up.................	“	“	40°,	“	“	30°.
Eyes down..............	“	“	40°,	“	“	40°.

These figures confirm very conclusively the results of the tests for the associated movements as given above. It was also proven that simultaneous vision with the two eyes existed, but not binocular fusion when the hypertropia was corrected by the proper adjustment with the amblyoscope.

V. Skeletal measurements showed, when patient stood fixating an object directly in front:

1. A head tilting to the left which made a difference of 7*mm* in level between the right and left eyes.

2. Left shoulder 7*mm* higher than the right. When head was forcibly straightened, the elevation of the left shoulder increased indicating a certain amount of torticollis.

3. The spine showed a slight double lateral curvature in the thoracic region, the upper curve being to the right and the lower to the left.

VI. Refraction following atropine cycloplegia showed:

ILLUSTRATING DR. HARVEY J. HOWARD'S ARTICLE ON "TENOTOMY OF THE INFERIOR OBLIQUE."

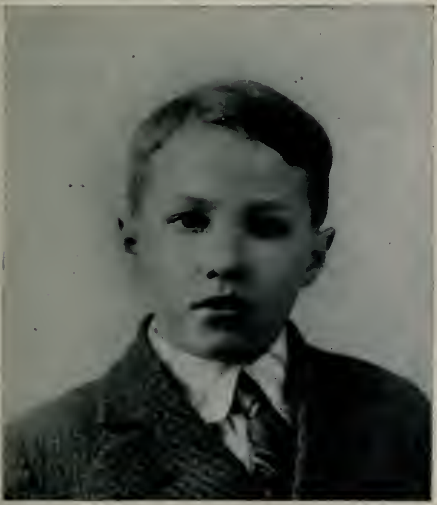

FIG. 1.—Right eye fixing, left hypoesotropia, left head tilting.

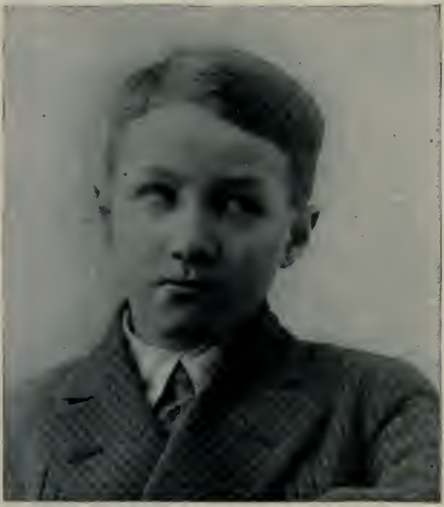

FIG. 2.—Looking up and to the left. Marked underaction of left superior rectus and spasm of right inferior oblique.

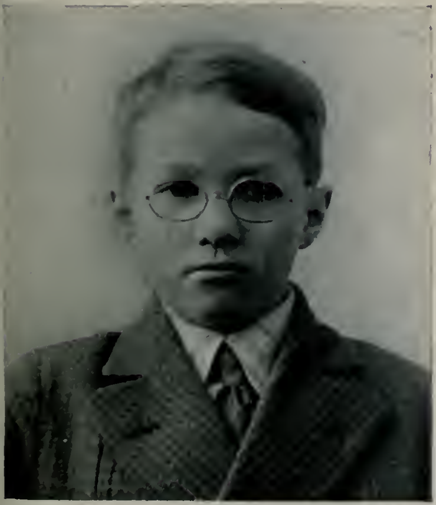

FIG. 3.—Right eye fixing with full correction on. Left hypoexotropia. Head was set straight by photographer.

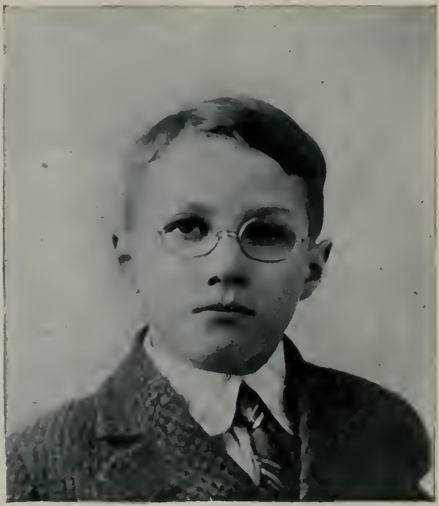

FIG. 4.—Left eye fixing with full correction on. Right hyperexotropia.

R: + 4.25 sphere, + 0.50 cyl. @ 90° = $\frac{20}{20}$ + ; L. + 4.00 sphere, + 0.50 cyl. @ 90° = $\frac{20}{15}$.

B. Tests with full correction on showed:

Practically the same results were obtained as were found before without correction with one striking exception. There was an alternating exotropia of about 36$^{\Delta}$ for distance as against an esotropia of 12$^{\Delta}$ without glasses, which made a difference of 48$^{\Delta}$ in the lateral deviation (Figs. 3 and 4).

The full correction was prescribed and after six months another examination was made which confirmed the earlier findings.

Inasmuch as the chief defect seemed to be that of the left superior rectus, it seemed advisable to tenotomize the inferior oblique of the right eye for the purpose of putting the visual axes of the two eyes more nearly into the same plane. It was not anticipated that such an operation would produce more than a partial correction. Not being associated with a hospital in New York City at that time, I asked my friend Dr. J. W. White, to whom I am indebted for the photographs of the case, to do the tenotomy, which he did. He "found an anomalous attachment of this muscle to the orbital plate of the superior maxillary bone. Instead of one insertion, there were two, one of which was found far to the outer side."

Five weeks later, I made another examination of the boy with the following result:

Without glasses: Esotropia for distance of 2$^{\Delta}$. Right hypertropia (with left eye fixing) of 30$^{\Delta}$. Left hypotropia (with right eye fixing) of 10$^{\Delta}$.

With full correction: Exotropia for distance of 16$^{\Delta}$. Right hypertropia of 30$^{\Delta}$. Left hypotropia of 10$^{\Delta}$.

With a 20$^{\Delta}$ prism vertically placed before one eye and a red glass before the other, two images were still visible, but they were on a horizontal line. By using the screen and parallax test, first before one eye and then the other when the prism was in this position, it was found that each eye came down behind the screen an amount equal to 10$^{\Delta}$, *i.e.*, there was an anatropia of 10$^{\Delta}$.

The operation, therefore, reduced the average deviation in a vertical plane by 5$^{\Delta}$, but it increased the anatropia by the same amount. The strange thing was that there was no decrease in the hypertropia of the right eye which was naturally expected from a cutting of one of its elevators. The decrease, however, in the hypotropia of the left eye must be attributed to the operation. That the effect occurred apparently upon the left eye rather than upon the right can be explained by the possibility of the patient tilting his head backwards a little more than he did before the operation, which would tend to neutralize somewhat the spastic action of the left superior oblique. That the same measurements of the vertical deviation were obtained by testing again and again would justify the conclusion that the position of the head in the primary position was permanently altered by the operation. It should be stated that the operation did not appreciably alter the head tilting to the left.

The most marked changes occurred in the lateral deviations. Without glasses the esotropia was reduced from 12^{Δ} to 2^{Δ}, *i.e.*, a difference of 10^{Δ}. With the full correction on the exotropia was reduced from 36^{Δ} to 16^{Δ}, or a difference of 20^{Δ}. In other words the difference in the lateral deviation without glasses and then with glasses was 18^{Δ} as against the 48^{Δ} that existed prior to the operation. If 18^{Δ} represents approximately the effect of relaxation of accommodation that occurred after the operation when the full correction was put on, then the balance of 30^{Δ} in the lateral deviation must be attributed in some way to the operation. In this connection it should be remembered that the inferior oblique muscle is an abductor as well as an elevator and that this power of abduction increases as the eye turns out, in the same proportion as its power as an elevator increases as the eye turns in. Therefore 20^{Δ} of this 30^{Δ} (or the difference between the exotropia of 36^{Δ} before the operation and of 16^{Δ} after operation obtained with glasses on) can be attributed to cutting of the inferior oblique of the right eye. The remaining 10^{Δ} of this 30^{Δ} is not as easily explained. Theoretically there should either have been no difference or possibly an actual increase in the esophoria without glasses before and after the operation, because with one abductor cut the adductors would tend to proportionately overact. True muscle conditions, however, are elicited only when any other contributing factor is eliminated. Therefore, in making a diagnosis we must primarily consider the findings when the eyes were made emmetropic.

From the father's statements as to the length of time the boy's eyes were affected, from the absence of history of injury or severe infectious disease, there is every reason to consider the condition congenital in origin. An exploratory operation was not done to determine whether there was an absence of the left superior rectus or a faulty insertion. Neither can we state that there existed any impairment of the nerve or nerve-nucleus supplying that muscle. The evidence indicating the possibility of an insertional anomaly was the fact that there was found an anomalous attachment of the inferior oblique of the right eye; also the marked correction of the exotropia following operation. The evidence, however, is not sufficient to warrant a more specific diagnosis than that of congenital underaction of the left superior rectus. The overaction of its associated antagonist, the right inferior oblique, could, however, easily be a secondary condition. An inability to look up and to the left although the necessity to do so is frequent and the desire is strong, naturally produces an overexcitation of the brain center controlling that pair of muscles, which while producing no response in the superior rectus, ultimately produces a spasm of the inferior oblique.

In view of all the above facts, the following *diagnosis* was made:

Congenital underaction of the left superior rectus and right inferior rectus; overaction (probably secondary spasm) of the right inferior oblique and left superior oblique; alternating exotropia with right hypertropia and an anatropia.

CASE 2.—Mrs. M. M. W., age 46, American. History of severe fall eighteen months before. Struck head on the left side at about the junction of the temporal, parietal, and occipital bones. Unconscious for several hours. Followed for six weeks by amnesia which gradually cleared up. Eye symptoms consisting of dizziness and diplopia for part of the time began immediately following consciousness. Menses at the time of the injury were occurring every two or three months. Following the injury they completely stopped and never returned. In view of the age of the patient this cannot be considered other than a coincidence.

Results of examination: Vision R. = $\frac{20}{30}$; L. = $\frac{20}{30}$.

Following homatropine refraction: Vision, R. + 0.50 cyl. @ 105° = $\frac{20}{20}$; L. + 0.50 cyl. @ 120° = $\frac{20}{20}$.

Screen and parallax test showed: Exophoria for distance of 5^{Δ}. Exophoria for near of 15^{Δ}. Right hyperphoria of 8^{Δ}. Prism sursumvergence power of 8^{Δ}.

With red glass before one eye, diplopia was always immediately induced showing that the patient was maintaining fusion only with great difficulty.

Near point of convergence = 160*mm.*

Associated movements' tests showed nearly complete underaction of the left superior rectus and some overaction of the right inferior oblique.

Diagnosis.—Traumatic paresis of left superior rectus and secondary spasm of right inferior oblique; primary convergence insufficiency with secondary divergence excess.

The condition seemed to call for a tenotomy of the inferior oblique of the right eye, which I did using novocaine injection.

At the end of a week, examination showed only 1^{Δ} of right hyperphoria remaining. The exophoria was unchanged, viz. 5^{Δ} for distance and 15^{Δ} for near. At the end of three months another examination showed the right hyperphoria still to measure 1^{Δ}. The exophoria had been reduced slightly, *i.e.*, to 3^{Δ} for distance and to 13^{Δ} for near. This reduction may have been brought about because the patient was resuming more and more the use of her eyes for near work, which she had totally avoided during the interim of the injury and the operation. This exercise would tend to increase her convergence power and in her case reduce the exophoria, although the latter result does not generally nor necessarily follow.

The patient was not subsequently seen, but at the last examination mentioned above, her symptoms of dizziness and frequent diplopia had absolutely disappeared. She was so much improved mentally and physically that she seemed like a different woman. Her only complaint was that her eyes quickly tired while doing near work. This was aggravated by the complication of a beginning presbyopia which called for a small plus correction in addition to the cylinders she wore, but which could not be given until her exophoria for near was considerably reduced. For this purpose she was instructed how to perform converging exercises for a period of several months and then report for another examination.

The operation itself produced an immediate and a permanent reduction of 7^{Δ} in her hyperphoria in the primary position. The 1^{Δ} of hyperphoria remaining was easily within her prism sursumvergence power which at the time of the operation was as much as 8^{Δ}. Her ability to look up and to the left was of course considerably limited, but there was no diplopia whenever she did so, for the reason that the underaction of the pair of associated antagonists which functioned in that field was equal and symmetrical.

The effect of the tenotomy in the first case was a reduction of 5^{Δ} in the vertical deviation. From the standpoint of the patient the effect was merely a cosmetic improvement largely due to a reduction in the exotropia. The effect of the tenotomy in the second case was a reduction of 7^{Δ} in the hyperphoria, which from the patient's standpoint resulted in a complete cure. Judging from the results of these cases and of other cases published, I suggest for vertical deviations of 10^{Δ} and over, due primarily to an underaction of a superior rectus, that an exsection of the inferior oblique of the opposite eye be performed rather than a simple tenotomy. Such a procedure can do no harm and it is quite possible that by it a greater permanent correction can be obtained.

It seems justifiable also to suggest the probability that anatropia is a far more common condition than is generally supposed. Whenever there is found a difference in the amount of the hypertropia and the hypotropia, there theoretically should and probably does exist an anatropia or a catatropia which is equal to one half of this difference. We should therefore, particularly in all cases of large deviations in a vertical plane, not only ascertain the degree of elevation of one eye, but also the degree of depression of the other.

OBSERVATIONS ON ONE HUNDRED CASES OF PRIMARY (ACUTE CONGESTIVE AND SUBACUTE) GLAUCOMA UNDER TREATMENT AT THE ROYAL LONDON OPHTHALMIC (MOORFIELDS) HOSPITAL DURING THE PAST FOUR YEARS WITH A COMPARISON OF VISUAL RESULTS.[1]

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IF ophthalmologists knew what maintained the normal intraocular pressure, they would be better able to understand the pathological cases, but until such time has arrived, much must remain unexplained in this branch of ophthalmology.

The classification followed in this series of cases was the one suggested by Colonel Elliot, namely, acute congestive and non-congestive glaucoma. Many of the acute cases, however, showed that a condition of chronic glaucoma had existed in the other eye at some period. No attempt was made to divide the cases into the various stages. Aside from operations, the treatment was the same for each case with the exception that most of the severe cases had leeches applied. Oily eserine 1% was used two or three times a day during the first twenty-four hours, followed by the aqueous solution ½% three times a day. Aspirin was occasionally given in large doses but morphine was seldom resorted to for the pain. The operated cases received calomel and salts, except those taken direct to the operating-room from the out-patient department. In all the trephined cases the Lang 1½*mm* instrument was used, after being tested with fine kid and examined with a binocular loupe. Most cases had one stitch of fine black silk in the conjunctival flap. A few patients had a Herbert's sclerotomy, but most of the acute cases had an iridectomy, the iris being torn out after being severed at one edge. A narrow Graefe knife was used to make the section.

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[1] Read before the Chicago Ophthalmological Society, Oct., 1919.

Following the operation, atropine sulphate ¼% was instilled in the operated eye by some surgeons, in other cases it was not used until the second day, when the anterior chamber was usually well reformed. Only the operated eye was bandaged.

The tension was seldom recorded with a Schiotz or McLean tenometer prior to operation. Fields were taken in nearly all the cases where the vision would permit, but chiefly at a later period when the eye had become quiet, following the operation for the relief of tension. Many of the cases did not attend the hospital for a long period after being discharged, so that it was impossible to keep a record of their progress.

Eliza W., aged 57, married, general health good. Admitted November 9, 1918, under Mr. Lawford. Patient contracted influenza October 18th. Left eye showed a condition of acute congestive glaucoma. Vision equaled hand movements with projection accurate. Greenish reflex. Fundus obscured. T. + 2.

November 13, 1918, left iridectomy under $CHCl_3$.

Discharged, November 29th. Left eye was quiet. Vision with −1.00 sph. and −4.00 cyl. was $\frac{6}{12}$. Lens uninjured. O. D. was not cupped, color was good. Tn.

Right eye. Vision with a + 3.00 sph. equaled $\frac{6}{9}$. O. D. normal. Tn.

Emma H., aged 57, married, general health good. Admitted, December 12, 1918, under Mr. Lawford. December 2, 1918, patient was struck in left eye by a piece of wood. Treated by a chemist with lotion but no "drops." On admission left eye showed a condition of acute congestive glaucoma. The cornea was not abraded and did not stain. No keratitis punctata or synechiæ were seen. Fundus was obscured. T. + 1. Vision equaled hand movements. December 15th nasal field contracted about five degrees between fifteenth and seventy-fifth meridians. A 10*mm* white square test object was used and the day light.

December 17th was discharged. Left eye was quiet.

Cornea was bright. Anterior chamber was shallow. Vision with a + 2.00 sphere equaled $\frac{6}{6}$. Tn. O. D. normal.

Right eye. Vision $\frac{6}{9}$; vision with a + 2.50 sph. was $\frac{6}{6}$. Anterior chamber was shallow. O. D. was normal. Tn.

Hannah H., aged 50, married, general health good. Had pyorrhœa very badly. Admitted July 13, 1918, under Mr. Lawford. Patient contracted influenza the last week in June. The left pupil was dilated, oval, and fixed. The optic disk was not cupped. Vision equaled $\frac{6}{36}$. The nasal field showed a contraction of 10 degrees between the fifteenth and ninetieth meridians. T. was + 1. The right eye was perfectly quiet.

On July 16th, the right eye suddenly developed an attack of acute congestive glaucoma (no eserine had been used in this eye, as the tension was normal on admission) and on the 17th, an iridectomy was necessary. The right vision, taken repeatedly in August, remained $\frac{6}{18}$ while on admission it was $\frac{6}{9}$ with correction.

Although the left eye was apparently normal, the tension remained + in spite of treatment, and on August 10th, an iridectomy was done under $CHCl_3$. On discharge, August 24th, the right vision with a + 3.00 sph. and − 6.00 cyl. was $\frac{6}{9}$. L. V. with a + 4.50 sph. and a − 6.00 cyl. was $\frac{6}{9}$. In neither case was the optic disk cupped. Tn. in each when discharged.

Harvey K., aged 70, married, general health good. Admitted May 29, 1918, under Mr. Lawford. On admission right vision was $\frac{6}{60}$. Fundus obscured. T. + 2. The patient had no treatment prior to admission.

June 1st, right eye was trephined under cocaine. June 11th, the vision was $\frac{6}{24}$. O. D was not cupped. Quiet. Tn. The left eye had occasional attacks of obscured vision the past eighteen months. On admission the eye was perfectly quiet. Vision equaled hand movements. T. was + 2. The optic disk was cupped. June 14th, left eye trephined—cocaine.

Discharged, June 22d. R. V. was $\frac{6}{18}$. L. V. was hand movements. Patient never had acute pain in his left eye.

Ellen S., aged 68, married; subject to rheumatism. Admitted May 3, 1918, under Mr. Lawford. No treatment. On admission, the right eye showed a condition of acute congestive glaucoma. The vision was reduced to counting fingers. T. was + 1. May 4th, had an iridectomy on right eye under $CHCl_3$.

Discharged, May 25th; right eye was quiet. Vision was $\frac{6}{24}$. Pillars were free. O. D. was not cupped. T. was −.

Left eye. Quiet. Full field. O. D. was normal. Vision equaled $\frac{6}{9}$. Tn.

Charlotte T., aged 61, widow, good health. Admitted January 11, 1918, under Mr. Lawford. Her present attack of pain in the right eye began in the early morning of January 3d. On admission the right eye showed a condition of acute congestive glaucoma. Vision was $\frac{6}{60}$. T. + 2. January 12th had a right iridectomy under $CHCl_3$.

Discharged, February 6th. Right eye was quiet. Vision with a + 2.50 cyl. was $\frac{6}{18}$. Iris pillars were free. Lens uninjured. O. D. was not cupped. Tn.

Left eye. In June, 1902, had an iridectomy at Moorfields Hospital for chronic glaucoma. Vision equaled hand movements. O. D. was cupped and atrophied.

Maud S., aged 31, single, good health. Admitted to Moorfields Hospital January 21, 1918, under Mr. Fisher. On January 19th, patient had her first attack of pain in each eye between midnight and dawn. Her family physician gave her morphia for the pain and vomiting. No eye treatment was instituted. January 21st, the day of admission, each eye showed a condition of acute congestive glaucoma. The vision was reduced to counting fingers. Right T. was + 2. L. T. was + 1. Treated with eserine forty-eight hours. January 23d had an iridectomy on each eye under CHCl3.

Discharged February 13th. Right eye showed nothing of special note beyond a small, rounded hemorrhage, about two disk diameters below the disk. Vision equaled $\frac{6}{12}$. Pillars were free and the lens was uninjured. Tn. O. D. was not cupped. Left eye was quiet. Vision was $\frac{6}{18}$. O. D. was not cupped. Iris pillars were free. Lens was uninjured and the tension was normal.

Issac P., aged 41, married, good health. Admitted July 17, 1918, under Mr. Fisher. On July 5th, patient had his first attack of pain in the right eye. No treatment prior to admission. T. was plus and the eye was painful. Vision equaled hand movements. Fundus obscured. July 22d, right eye was trephined under novocaine. The next day the anterior chamber was almost full of blood. There was no history or signs of an injury to the eye.

Discharged August 8th. The right eye was slightly injected. A small hyphæma was present. Vision equaled P. L. with projection accurate. Pupil remained dilated although this case received no mydriatic at any time. Fundus obscured by vitreous haze. Tn. Trephine opening was apparently working well. Tn. Left eye—normal. Vision equaled $\frac{6}{6}$.

Grace B., aged 25, single, domestic, general health good. Admitted January 10, 1918, under Mr. Fisher. She had no treatment. The pupil was semi-dilated and acted fairly well. The margins of the optic disk were slightly blurred. No cupping was present. Vision was $\frac{6}{12}$. Tension with the Schiotz tenometer registered 38*mm Hg*. Arterial pulsation of the retinal vessels was present. January 11th, 14th, and 18th, patient had a right paracentesis under cocaine. In spite of this and eserine, the tension remained pathological, and on January 25th a Herbert's sclerotomy was performed.

Discharged February 1st. Cornea was bright. Pupil was active and circular. Vision equaled $\frac{6}{9}$. O. D. was slightly blurred. Tn.

Left eye. Appeared normal. Vision equaled $\frac{6}{9}$. Tension with Schiotz registered 19*mm Hg*. Optic disk was normal.

Harriet W., aged 61, married, good health. Admitted February 1, 1918, under Mr. Fisher. On January 28, 1918, the right eye was slightly painful for the first time. She was treated by her family physician with "drops." On admission the right eye showed a typical attack of acute congestive glaucoma. There were about 20 degrees of convergence present. Vision equaled counting fingers. Faint red reflex. T. + 1. February 1st, had a right iridectomy under novocaine.

Discharged February 15th. Cornea was bright. Iris pillars were free. Anterior chamber was shallow. Vision equaled $\frac{6}{60}$ unaided and was not improved. Optic disk was normal.

Left eye. Operated at Moorfields January 14, 1908, for acute glaucoma. Vision equaled $\frac{6}{12}$. O. D. was cupped. Iris pillars were free. Tn.

Emily H., aged 63, married, subject to rheumatism. Admitted May 2, 1918, under Mr. Hudson. Right eye became painful the first week of April. No treatment prior to admission. On admission right eye showed a condition of acute congestive glaucoma. Vision equaled counting fingers. Faint red reflex. T. + 1, with the Schiotz tenometer, 42*mm Hg*. May 2, 1918, right eye trephined under novocaine. May 6th, a small hemorrhage was seen two disk diameters to nasal side of O. D.

May 23d, discharged. Right eye was quiet. Anterior chamber was reformed but shallow. Cornea was bright.

No keratitis punctata seen. Vision was $\frac{3}{60}$. Vitreous opacities. Tn. O. D. was not cupped.

Left eye. Vision was $\frac{6}{6}$. Anterior chamber was shallow. Normal disk. Tn.

Edith N., aged 53, married, good health. Admitted June 14, 1918, under Mr. Collins. Treated by her family physician with "drops" prior to coming to Moorfields Hospital. Fundus was obscured. R. Vision equaled hand movements. T. with Schiotz tenometer was 40*mm Hg.* June 14, 1918, she had an iridectomy under CHCl3. The incision was made with a keratome.

July 4th, discharged. The right eye was quiet. The cornea was clear. A small hyphæma was present. Iris pillars were free. The vitreous was hazy. O. D. was cupped. Vision equaled $\frac{4}{60}$. Tn.

Left eye. Quiet. Anterior chamber rather deep. Pupil was active and circular. Normal disk. T. with Schiotz tonometer was 30*mm Hg.* Vision equaled $\frac{6}{9}$.

Louisa T., aged 62, single, good health. Admitted February 6, 1918, under Mr. Greeves. L. Vision equaled shadows, projection was accurate. T. with Schiotz tenometer was 39*mm Hg.* Fundus obscured. Present attack was of seventy-two hours' duration. February 6th. L. glaucoma, iridectomy under novocaine.

Discharged February 27th. Cornea was still hazy. Iris pillars were free. Many vitreous opacities obscured the optic disk and fundus details. Vision equaled $\frac{6}{60}$. May 15, 1918, L. V. $\frac{6}{12}$.

Right eye. Operated for chronic glaucoma (iridectomy), September 5, 1901. Vision equaled $\frac{6}{60}$. Optic disk was cupped.

Rachel S., aged 48, married, good health. Admitted, February 4, 1918, under Mr. Greeves. The only treatment patient had was hot applications at home. On admission the eye showed a state of acute congestive glaucoma. L. Vision equaled $\frac{4}{60}$. Fundus was obscured. Tension with Schiotz registered 40*mm Hg.* February 6th, left eye was trephined.

February 16th, discharged. Left eye was quiet. Cornea was bright. O. D. was slightly cupped. Vision equaled $\frac{6}{12}$. Tn.

Right eye. Quiet. Vision was $\frac{6}{12}$ unaided. O. D. normal. Tn.

Annie C., aged 75, married, general health fairly good. Had rheumatism about twenty years ago in her joints.

Admitted December 10, 1917, under Mr. Parsons. Treated by her family physician. On admission the right eye showed an attack of acute congestive glaucoma. December 10th R. iridectomy under CHCl3. December 11th, when I dressed the wound, the lens was between the lids. The lens capsule was opened when section was made. The eye, however, showed nothing of special note. The vision on admission equaled hand movements. T. was + 2.

January 5th discharged. R. quiet. No keratitis punctata but the iris pillars were both drawn up to the wound. Some lens material was present in the coloboma area. Vision equaled hand movements with projection accurate. Tn.

Left eye was quiet. Lens opacities. Vision was $\frac{6}{18}$. Field showed a concentric contraction of approximately 10 degrees. T. was normal.

Harriet H., aged 65, single, good health. Admitted, April 29, 1918. Left eye was first inflamed and painful April 15, 1918. Treated by her family physician with "drops and lotion." On admission eye showed a state of acute congestive glaucoma. Vision was reduced to hand movements. Fundus obscured. T. + 1. May 4th had a paracentesis under cocaine. Treated with eserine until May 14th without much success. L. iridectomy under $CHCl_3$ May 14th. The next day a large hyphæma was present, although there was no history of injury to the eye.

May 31st discharged. Left eye was quiet. Cornea was bright. Iris pillars were free. The anterior chamber contained some blood. Vision equaled $\frac{3}{60}$—due to hyphæma. O. D. was not cupped. T. was normal.

Right eye was blind from chronic glaucoma. Vision equaled P. L. T. was + 1. Lens opacities. Faint reflex.

Rose O., aged 48, widow, good health. Admitted March 21, 1918, under Mr. Spicer. On admission left eye showed a condition of acute congestive glaucoma. Vision was $\frac{6}{36}$. Fundus details were obscured and the T. was + 1. The left field showed a nasal contraction of less than 10 degrees between the 30th and 120th meridians. May 22, 1918, an iridectomy was done under $CHCl_3$.

April 2d, discharged. Left eye was quiet. Cornea was clear. Iris pillars were free. Vision was $\frac{6}{18}$. O. D. was not cupped. Tn.

Right eye was quiet. Vision equaled $\frac{6}{6}$. Normal fundus. Tn. Full field. June 25, 1918, R. V. was $\frac{6}{6}$. L. V. $\frac{6}{6}$.

Emma H., aged 56, married, good health. Admitted, November 22, 1917, under Mr. Hepburn. Used "drops" from a general practitioner, until the 22d. On admission the right eye showed a condition of acute congestive glaucoma. Vision was hand movements. Faint fundus reflex. T. was + 2. November 23, 1917, an iridectomy was done under $CHCl_3$.

December 6th, discharged. Right eye was quiet. Vision was $\frac{6}{60}$ (lens opacities). Iris pillars were free. Vitreous opacities. O. D. was not cupped and the color was good. Tn. Left eye was quiet. Vision equaled fingers. Lens opacities. T. was normal. Many floating opacities were seen in the vitreous. Patient has since had a combined extraction but the vision was only $\frac{6}{60}$ in June, 1918, due to the vitreous opacities chiefly. The macula was normal.

Harriet M., aged 57, married, good health. Admitted May 28, 1918, under Mr. Hepburn. On admission the right eye showed a state of acute congestive glaucoma. Vision equaled fingers. T. + 1. May 30th right trephined under cocaine.

June 20th, discharged. Right eye was quiet. Vision was $\frac{6}{60}$. Tn. O. D. was cupped and pale.

Left eye. Quiet. Was an in-patient at Moorfields in August, 1912, with a hypopyon ulcer. Vision only light perception. Leucoma corneæ. T. +.

Rebecca B., aged 71, single, very deaf, good health. Admitted, March 25, 1918, under Mr. Hepburn. Treated by her doctor with "drops." L. Had acute congestive glaucoma on admission. Vision was hand movements. T. + 1. March 26th had left iridectomy under $CHCl_3$.

The right eye on admission was quiet. Vision was $\frac{6}{24}$. Vision with a − 3.00 sph. was $\frac{6}{6}$. Tn. Fundus normal.

About six hours after the left eye was operated, the right eye developed an attack of acute congestive glaucoma. The vision was only hand movements. T. + 1. The right eye was treated until March 28th and then had an iridectomy under $CHCl_3$.

On discharge, April 18, 1918, both eyes showed a very similar condition, the vision in each being $\frac{6}{18}$ unaided. Tn. Iris pillars were free. The disks were not cupped.

Sarah W., aged 64, married, good health. Admitted September 12, 1918, under Mr. Hudson. No treatment. On admission right eye had acute congestive glaucoma. Vision equaled P. L. T. + 2. September 12th an iridectomy was done under $CHCl_3$; incision entirely corneal.

Discharged, September 26th. R. V. equaled P. L. Cornea was slightly hazy. Iris pillars were free. Vitreous opacities. O. D. was obscured. Tn.

Left eye. Quiet. Vision was $\frac{6}{12}$. Nasal field showed about 5 degrees' contraction, chiefly above. O. D. slightly cupped, color was good. Tn.

Mary C., aged 82, married. Admitted, January 3, 1918, under Mr. Fisher. December 26, 1917, left vision failed rather suddenly after the eye was struck by an elastic band. Treated by her family physician with "drops" prior to admission to Moorfields. Left eye had acute congestive glaucoma, on admission. Vision equaled hand movements. T. + 2. Fundus was obscured. Treatment failed to reduce the tension to normal. January 5th left iridectomy under $CHCl_3$.

Discharged, January 21st. Left cornea was still slightly hazy. Anterior chamber was well re-formed. Iris pillars were free. Lens was clear. Vitreous opacities obscured the fundus details. Vision equaled fingers. T. was normal.

Right eye was excised at Great Northern Hospital in 1906.

George G., aged 57, married, soldier, good health. Admitted, January 23, 1918, under Mr. Collins with an attack of acute congestive glaucoma in the left eye. Vision equaled fingers. Fundus obscured. T. + 1. January 24th left trephined under novocaine.

February 11th discharged. Left was quiet. Vision was $\frac{6}{18}$. O. D. was normal. Tn. Drainage was perfect.

Right eye. Sight failed in 1913. Glaucoma iridectomy same year. History was that of chronic glaucoma.

William C., aged 67, widower, good health. Admitted March 9, 1918, under Mr. Hepburn, with acute congestive glaucoma, left eye. Vision equaled $\frac{2}{60}$. Fundus was obscured. T. + 1. March 10th an iridectomy was made under $CHCl_3$.

Discharged, March 20th. Cornea was bright. Pillars were free. Vision with a + 2.50 sph. was $\frac{6}{12}$. O. D. was normal. Tn. Right eye was operated at Moorfields Hospital for acute congestive glaucoma on April 11, 1916. Vision equaled $\frac{6}{60}$. Macular changes. Tn.

Mathilda O., aged 46, single, dressmaker, good health. Admitted February 2, 1918, under Mr. Hepburn. Right eye became inflamed and painful January 30, 1918. Was treated with eserine and hot bathing by her family physician. On admission vision was $\frac{6}{6}$ unaided. Full field. T. + O. D. was not cupped. February 5th an iridectomy was done under $CHCl_3$.

Left eye. Patient saw halos at times the past two years.

Never had emesis or severe pain. Vision was $\frac{6}{6}$. O. D. was normal. Tn.

February 21st, discharged. Right and left vision was $\frac{6}{6}$. Right pillars free. Tn.

Emma M., aged 42, married, good health. Admitted July 4, 1918, under Mr. Worth. On admission the right eye showed a state of acute congestive glaucoma. Treated with eserine, heat, and leeches. Vision on admission was hand movements.

Left eye. Operated for chronic glaucoma at St. Thomas's Hospital, 1912. Vision equaled shadows. O. D. was pale and cupped. Fundus showed old choroidal changes.

July 15, 1918, discharged. Right eye was quiet. Cornea was bright. O. D. was not cupped. Vision equaled $\frac{6}{60}$. Fundus showed old choroidal changes. Tn.

Charlotte M., aged 67, married, good health. Admitted May 17, 1918, under Mr. Flemming. February 5th patient had her first attack of obscured right vision. Came as an out-patient March 12th. R. V. was $\frac{6}{18}$. Vision with a − 2.00 sph. was $\frac{6}{6}$. May 17th, homatropine and cocaine were put in each eye by mistake by the nurse in the out-patient room. In a few hours the patient had pain and the pupils were widely dilated. The vision was reduced to fingers and the T. was + 1 in each eye. Patient was under eserine, each eye, since the first time she came to the hospital (March 21, 1918). The vision in the left eye was $\frac{4}{60}$ at this time and was not improved with lenses. The T. was full.

Discharged, May 24, 1918. R. V. equaled $\frac{6}{18}$; with a − 2.00 sph. equaled $\frac{6}{12}$. Nasal field was contracted. O. D. was not cupped. T. was normal. Left eye. Vision was defective since 1917. T. full. O. D. was cupped and pale.

December 31, 1918, readmitted. January 3, 1919, right was trephined under cocaine. January 21st discharged. R. V. equaled $\frac{6}{36}$. Tn. Drainage was good. Nasal field almost obliterated. L. V. equaled no P. L. T. + 1. Not painful.

Richard P., aged 44, married, transport worker, good health. Admitted, January 1, 1918, under Mr. Flemming. On admission right vision was $\frac{6}{36}$. The O. D. was not cupped. The T. was +. The left eye was quiet. Chamber was shallow. Pupil was active. Vision was $\frac{6}{9}$. Normal disk. Tn. Full field.

Discharged, January 4, 1918. Right eye was slightly injected. Pupil was pin-point. Anterior chamber was shallow. Tn. Given eserine for use at home. Full field. August, 1918, R. V. was $\frac{6}{9}$, L. V. was $\frac{6}{6}$.

Rosetta R., aged 72, widow, general health was fairly good. Admitted February 1, 1918, under Mr. Flemming. On admission she had acute congestive glaucoma in the left eye. Vision was hand movements. Fundus was obscured. T. + 1. February 1st had an iridectomy on left eye under $CHCl_3$.

February 12th discharged. Left cornea was bright. Iris pillars were free. A few vitreous opacities were present. Vision was $\frac{6}{60}$. Tn. Right eye was operated for chronic glaucoma at Moorfields Hospital, June 6, 1916 (iridectomy). Vision equaled $\frac{6}{24}$. O. D. was pale and cupped. T. was normal.

Georgine T., aged 35, married, pyorrhœa, general health good. Admitted December 6, 1918, under Mr. Flemming. On admission fundus was obscured. Right vision equaled fingers. T. was + 2. December 12th right trephined under cocaine.

December 20th, discharged. Right cornea was bright. Vision with a + 2.50 cyl. axis H. equaled $\frac{6}{18}$. Tn. Drainage was good. O. D. normal.

Left eye was quiet. Chamber was shallow. O. D. normal. Vision with a + 0.75 sph. and a + 2.00 cyl. equaled $\frac{6}{6}$. T. was normal.

Thomas P., aged 76, widower, good health. Admitted September 18, 1918, under Mr. Flemming. Patient attributed the onset of his eye trouble to worry. On admission the left eye showed a condition of acute congestive glaucoma. A large hyphæma was seen. September 20th an iridectomy was done under novocaine. The tension persisted and the eye was excised on October 10, 1918.

The right eye was normal. Vision equaled $\frac{6}{6}$. Tn. Full field. On pathological examination of the left eye I found the angle closed. The optic nerve was deeply cupped. No evidence of cyclitis was present.

Florence S., aged 56, married, subject to bilious attacks. Admitted, January 26, 1918, under Mr. Greeves. On admission the left eye was in a state of acute congestive glaucoma. Vision equaled fingers. T. was + 1. January 30, 1918, left trephined, under novocaine.

In the right eye the symptoms were less marked. The cornea was hazy and the pupil dilated. Vision equaled $\frac{6}{36}$. T. + 1. O. D. was not cupped. The right field showed about a 20 degree concentric contraction. February 13th, right trephined under cocaine.

February 27th, discharged. Left quiet. Vision was $\frac{3}{60}$.

O. D. was cupped and pale. Tn. Right eye was quiet. Vision equaled $\frac{6}{18}$. O. D. not cupped. Tn.

Alice P., aged 50, single, good health. Admitted, August 7, 1918, under Mr. Greeves with subacute glaucoma in each eye. Vision in each was $\frac{6}{60}$ and the T. +. August 10th left trephined and August 24th right trephined under novocaine.

Discharged, September 4th. Right cornea was bright. Pupil was dilated and circular (atropine in ward). Vitreous was cloudy. Vision equaled hand movements. Tn. O. D. not seen.

The left eye was quiet. Vision equaled $\frac{6}{36}$. O. D. normal. Tn.

December 4, 1918, R. V. equaled $\frac{6}{60}$. L. V. equaled $\frac{6}{9}$.

Nathan T., aged 53, clerk, married, good health. Admitted December 20, 1918, under Mr. Hudson, with subacute glaucoma in the left eye. On admission the pupil was pin-point (eserine). Vision was $\frac{6}{6}$. Shallow chamber. Full field. Tn.

Right quiet. Lens opacities. Vision was $\frac{6}{36}$. T. was full.

Discharged December 23d. T. normal in each eye.

January 8, 1919, began to see rainbows with right eye. Pupil was semi-dilated under eserine treatment. Vision $\frac{6}{60}$. January 27th right trephined. A bead of vitreous was lost at operation. Field showed 10 degrees' contraction above between fifteenth and ninetieth meridians.

February 6th, discharged. Right quiet. Vitreous was hazy. Vision was $\frac{6}{60}$. Tn. Left was quiet. Vision was $\frac{6}{6}$. Tn.

Mary B., aged 58, married, good health. Admitted October 9, 1918, under Mr. Fisher. Vision equaled fingers. T. was + 2. Fundus was obscured. No treatment prior to admission. October 15th left was trephined under cocaine.

Discharged, October 29th. Left was quiet. Vision was $\frac{6}{18}$. O. D. normal. Tn. Drainage was good. January 28, 1919, L. V. was $\frac{6}{9}$ with a + 0.50 Cyl. Right chamber was shallow. Normal disk. Field was full. Vision was $\frac{6}{6}$. Tn.

Clara B., aged 47, married, good health, munition worker. Admitted, November 13, 1918, under Mr. Fisher. Treated by her doctor with "drops." On admission vision equaled fingers. T. + 1. Fundus was obscured. November 15th a paracentesis was done—cocaine. November 29th right eye was trephined. A large piece of iris was excised—cocaine.

December 2d, discharged. R. V. was $\frac{6}{6}$. Full field. Tn.

L. V. was $\frac{6}{6}$. Chamber was shallow. Pupil, eccentric and sluggish. O. D. was normal. Tn. Full field.

July 8, 1919, R. V. with a + 1.50 sphere was $\frac{6}{9}$. O. D. normal.

Maria F., aged 67, married, good health. Admitted, November 6, 1918, under Mr. Flemming. On admission the fundus was obscured and the T. + 1. No treatment was given prior to November 5th, at which time she came as an out-patient.

November 8th an iridectomy was done under novocaine.

November 27th discharged. Cornea was bright. Pupil dilated and the nasal pillar was drawn up toward the scar above. Lens opacities were present and the vitreous was cloudy. O. D. not seen clearly. Vision equaled fingers. Tn. The eye was not injected.

Left eye was quiet. Chamber was shallow. Vision was $\frac{6}{18}$. Vision with a + 2.00 sph. was $\frac{6}{6}$. Full field. Tn.

April 29, 1919. Left eye was trephined under novocain, as the nasal field was becoming contracted and the vision was failing.

Discharged, May 6th. L. V. was $\frac{6}{12}$. O. D. not cupped. Tn. Good drainage.

Mary S., aged 41, single, dressmaker. Admitted, August 1, 1918, under Mr. Hepburn. Was operated for appendicitis; thrombosed veins in the right leg followed during the summer of 1918, otherwise has always been healthy. On admission the eye showed a condition of acute congestive glaucoma. August 6th a right paracentesis was done under cocaine. August 7th and 8th R. T. was +. August 8th an iridectomy was made under $CHCl_3$.

Discharged, August 18th. Right cornea was still hazy. Iris pillars were free. Anterior chamber was shallow. Vitreous was cloudy. Vision with a + 5.00 cyl. equaled $\frac{6}{24}$.

She had no treatment prior to admission.

L. V. with a + 3.50 sphere and a + 2.00 cyl. equaled $\frac{6}{6}$. T. was full. Treated with eserine.

Thomas W., aged 74, widower, good health. Admitted December 2, 1918, under Mr. Hepburn. March, 1918, contracted influenza and both eyes were inflamed three weeks. Lens opacities. R. V. equaled $\frac{6}{18}$. On admission the left pupil was dilated and inactive. Vision equaled fingers. T. + 1. December 5th an iridectomy was made on the left eye under $CHCl_3$. December 30th, discharged. Left was quiet. Cornea was hazy. Iris pillars were free. Lens opacities. Vision equaled fingers. Fundus obscured. Tn.

Right eye had lens opacities. Vision was $\frac{6}{18}$. Tn. The anterior chamber was shallow and the pupil reacted sluggishly.

Alice B., aged 72, widow, fair health. Admitted January 6, 1919, under Mr. Hepburn. Since January 2d, saw only light. On admission right eye was injected. Vision equaled P. L. T. was + 2. Fundus obscured. January 9th, had a right iridectomy under $CHCl_3$.

January 23d discharged. Right eye showed a slight degree of injection. Iris pillars were free. Vitreous was cloudy. Vision equaled fingers. Tn. Retina detached.

Left eye. Vision was $\frac{6}{18}$; with a + 3.00 sph. equaled $\frac{6}{9}$. Chamber was shallow. Tn. Full field.

Julia W., aged 49, married, good health. Admitted, January 7, 1919, under Mr. Hepburn. Treated by her doctor with "drops." On admission vitreous was cloudy. Vision with a + 1.50 sph. equaled $\frac{6}{18}$. Tn.

January 9th, left iridectomy under $CHCl_3$.

January 23d, discharged. Left eye was quiet. Cornea was bright. Vision with a + 2.50 sph. and a + 1.00 cyl. H. was $\frac{6}{18}$. O. D. not cupped. Tn.

Right chamber shallow. Pupil circular and active. Vision $\frac{6}{6}$. Full field. Tn.

February 10, 1919, L. V. with correction equaled $\frac{6}{6}$.

Emily W., aged 49, married, laundress, good health. Admitted February 4, 1918, under Mr. Hepburn. On admission both eyes had subacute glaucoma. L. V. equaled fingers. T. + 1. Fundus obscured. R. V. = $\frac{6}{60}$

February 15th, left had a paracentesis under cocaine.

February 18th, left was trephined, under cocaine. February 20th, left anterior chamber was full of blood, and was very painful. T. was normal.

March 7th, right was trephined.

March 28th, discharged. Left was quiet. Cornea was clear. Hyphæma. Vision was $\frac{6}{24}$. O. D. was cupped. Tn. Right was also quiet. Vision equaled $\frac{6}{60}$. O. D. was cupped and pale. Tn. March 13, 1919, L. V. was $\frac{6}{6}$ unaided. Tn. O. D. slightly cupped.

Julia A., aged 53, widow, good health. Admitted, December 31, 1918, under Mr. Hepburn. Treated with eserine drops by her family physician. On admission the left cornea was hazy. The chamber was shallow and the pupil contracted. Vision was $\frac{4}{60}$. Left field showed about a 25 degree nasal contraction. T. + 1. O. D. cupped and pale.

January 2, 1919, left trephined under novocaine.

January 17th, discharged. Cornea was bright. Vision was $\frac{6}{60}$. O. D. was cupped. Tn.

Right was quiet. Shallow chamber, normal fundus. Vision equaled $\frac{6}{9}$. Tn. Full field.

April 10, 1919, L. V. with a -5.00 sphere and a -0.75 cyl. equaled $\frac{6}{18}$.

Thomas P., aged 74, widower, salesman, good health. Admitted March 3, 1919, under Mr. Hepburn. Present attack in right eye began February 26th. No treatment. On admission there was ptosis of each lid. The right eye showed a condition of acute congestive glaucoma. Vision was hand movements. Fundus was obscured. T. + 2.

March 4, 1919, right iridectomy was made under $CHCl_3$.

March 17th, discharged. Cornea was bright. Iris pillars were free. Lens opacities obscured the O. D. Vision equaled fingers. Tn.

Left eye. The chamber was shallow. Vision was $\frac{6}{12}$. T. full. Field was not contracted. O. D. normal.

Robert F., aged 57, married, gas-fitter, good health. Admitted March 5, 1919, under Mr. Moore. On admission the left eye showed a state of acute congestive glaucoma. No treatment prior to admission. The vision equaled fingers. T. + 1. Fundus was obscured.

March 5, 1919, left iridectomy—$CHCl_3$.

March 15th, discharged. Cornea was bright and the iris pillars were free. Vision with a $-.75$ sph. and a $+3.00$ cyl. axis H. was $\frac{6}{24}$. O. D. normal. Tn.

Right eye was operated in 1914 for chronic glaucoma at Moorfields Hospital. Vision was $\frac{6}{18}$. O. D. was cupped. Iris pillars were free and the Tn.

Elizabeth E., aged 60, married, good health. Admitted, February 5th, 1918, under Mr. Moore with acute congestive glaucoma in the left eye, of twenty-four hours' duration. Had a similar attack five weeks before, but less severe. No treatment. Vision equaled fingers. Fundus was obscured. T. + 2.

February 26th, a left iridectomy was done under $CHCl_3$.

March 12th, discharged. Left cornea was bright. Wide iridectomy. O. D. normal. Vision was $\frac{6}{36}$. Tn.

Right vision was $\frac{6}{12}$; with a $+3.50$ sphere was $\frac{6}{5}$. Nasal field was contracted about 10 degrees between fifteenth and seventy-fifth meridians.

George T., aged 74, single, fairly good health. Admitted May 20, 1919, under Mr. Flemming, with acute congestive glaucoma in the right eye. Duration was six days. Treated with "drops and lotion." Vision was reduced to P. L. T. was + 2.

May 30, 1919, an iridectomy was made under novocaine.

June 24th, discharged. Right eye was still injected. No keratitis punctata was seen. Iris pillars were free. Much lens opacity. Fundus obscured. Vision equaled P. L. with projection quick and accurate. Tn.

Left eye. The chamber was shallow. The pupil acted well. Lens opacities obscured the fundus details. Vision equaled $\frac{6}{18}$. T. full.

Edgar F., aged 42, married, good health, baker. Admitted June 17, 1918, under Mr. Hudson.

The right vision failed suddenly and when he came to the out-patient department the right eye was in a state of acute congestive glaucoma. The vision was reduced to P. L. and the T. was + 2. There was a defect in the lower temporal field, although this was difficult to outline owing to his poor sight.

June 17th the right eye was trephined under novocaine. The iris bled freely when the small iridectomy through the trephine opening was made.

June 27th was discharged. The right eye was still injected but there were no deposits on the cornea and no synechiæ were seen. The fundus was dimly seen. Vision equaled no P. L. Tn. Good drainage.

Left eye. Vision $\frac{6}{6}$. The chamber was shallow. Tn.

Edith B., aged 63, single, good health. Admitted June 23, 1919, under Mr. Worth. First attack of obscured vision and halos was in May, 1919, in the left eye. No treatment. Present attack began a few days before admission. Fundus details were obscured. Vision equaled $\frac{2}{60}$. T. + 1.

June 26, 1919, left was trephined under novocaine.

Discharged July 10th. Left eye was quiet. Vision equaled $\frac{6}{24}$. O. D. was cupped but the color was good. Tn. Good drainage.

Right eye. Vision $\frac{6}{60}$; vision with a + 6.00 sph. was $\frac{6}{12}$. Chamber was shallow. Pupil active and circular. Tn. O. D. was not cupped.

Annie G., aged 53, married, pyorrhœa, varicosed veins, otherwise healthy. Admitted, June 16, 1917, under Mr. Parsons. No treatment. On admission left eye was in a state of acute congestive glaucoma. Vision equaled fingers. Fundus was obscured. T. + 1.

June 20th left iridectomy was made under $CHCl_3$.

July 5th discharged. Left cornea was bright. Iris pillars were free. Vision was $\frac{6}{24}$. Vitreous hazy. O. D. not cupped. Tn. The left field showed about 20 degrees nasal contraction.

Right eye. Chamber shallow. Pupil active and circular. Normal fundus. Vision $\frac{6}{18}$. Field full.

Rose C., aged 50, married, good health. Admitted, September 1, 1917, under Mr. Parsons. No treatment. On admission the right cornea was hazy. Anterior chamber was shallow. Pupil was dilated and inactive. Vision equaled $\frac{6}{18}$; not improved with lenses. O. D. was not cupped. T. + 1.

September 8, 1917, an iridectomy was made under $CHCl_3$.

September 29th, discharged. Right cornea was clear. Pillars were free. Chamber was shallow. Small hyphæma. Vision was $\frac{6}{60}$. O. D. was slightly cupped.

Henry G., aged 65, married, fairly good health. Admitted, September 5, 1917, under Mr. Parsons. No treatment. On admission the right cornea was hazy. Much engorgement of the ciliary vessels was present, and the pupil was dilated and fixed. Lens opacities. Vision was reduced to fingers. Six hours after eserine was used vision equaled $\frac{6}{36}$. September 8th O. D. was seen and no cupping was present.

September 15th, right trephined under cocaine.

The left eye showed a smilar state on admission. The vision was $\frac{6}{60}$ and six hours after treatment was $\frac{6}{12}$. The optic disk was not cupped.

September 18th, left eye was trephined—cocaine.

Discharged, September 22d. R. V. equaled $\frac{6}{36}$. O. D. not cupped. Right field showed about 25 degrees contraction of the nasal field. L. V. equaled $\frac{6}{9}$. Nasal field contracted above about 10 degrees. Lens opacities were seen at the periphery of the lens.

Elizabeth P., aged 63, married, good health. Admitted, under Mr. Parsons, January 24, 1917. Came as an outpatient January 20th and refused to be operated. Given eserine ½%. Right eye inflamed and painful in December, 1916. On admission right eye showed a condition of acute congestive glaucoma. Vision equaled hand movements. T. + 1. Left eye was painful two days, on admission, and showed a similar condition as right eye. Vision equaled fingers. T. + 1. Although she used eserine and hot applications at home the left eye was little benefited.

January 24, 1917, an iridectomy was done under $CHCl_3$.

Discharged, February 7th; left was injected. No keratitis punctata seen. Hyphæma. Pillars were free. Vision $\frac{6}{36}$. Tn. Refused operation on right. The right cornea was hazy. Vision equaled hand movements. T. +. Pupil semi-dilated. Vitreous hazy. O. D. obscured.

August 9, 1919. L. V. equaled $\frac{6}{18}$. O. D. was not cupped. R. V. was $\frac{6}{36}$. O. D. was cupped.

Eliza D., aged 68, married, good health. Admitted February 2, 1917, under Mr. Parsons. Left eye first inflamed in January, 1917. No treatment. On admission the left eye showed a condition of acute congestive glaucoma. Vision equaled fingers. Fundus was obscured. T. + 1.

The right eye first became inflamed four days after the left. There was no history of emesis or halos. On admission the eye was much injected and very painful. It showed a similar condition to the left. Vision equaled hand movements. T. + 1. Fundus was obscured.

February 3d, right and left iridectomy under $CHCl_3$.

February 21st patient injured his right eye which was followed by marked ciliary injection.

Discharged, March 3, 1917. Left cornea was still hazy. Nasal pillar drawn up to incision above. No keratitis punctata. Fundus details not seen clearly. Tn. Vision equaled fingers. Lens opacities obscured the fundus.

Right eye. Cornea was distinctly hazy. No deposits on posterior surface. Iris pillars were free. No synechiæ were seen. Much lens opacity. Vision equaled P. L. No inflammatory deposits were present in the coloboma area or on the lens capsule. The fundus was obscured. Tn.

Lydia McC., aged 60, widow, good health. Admitted November 2, 1917, under Mr. Flemming. Left was first inflamed October 20th. On admission the left eye showed a condition of acute congestive glaucoma. Vision equaled hand movements. T. + 2. Fundus was obscured.

November 2, 1917, left iridectomy was made under $CHCl_3$.

November 27th discharged. Left was quiet. Iris pillars were free. Small hyphæma was present. Vitreous hazy. Vision equaled $\frac{4}{60}$. O. D. slightly cupped. Tn.

Right quiet. Chamber was shallow. Vision was $\frac{6}{24}$; vision with a + 3.00 sphere was $\frac{6}{6}$. Tn. January, 1919, R. V. equaled $\frac{6}{6}$ with above glass and J. 1 with a + 5.00 sphere. L. V. equaled $\frac{6}{24}$.

Elizabeth R., aged 66, married, pyorrhœa, good health. Admitted, May 17, 1917, under Mr. Flemming. No treatment. On admission the left eye showed a condition of subacute glaucoma. Pupil was small (eserine from out-patient department) and round. Chamber was shallow. Lens opaque. Vision equaled fingers. T. + 1.

May 18th left iridectomy was made under novocaine.

May 21st patient struck her left eye with her hand, which was followed by a hyphæma.

June 5th, discharged. Left eye was quiet. Cornea was bright. No keratitis punctata. Iris pillars were free. Lens opacity obscured the fundus. Vision equaled fingers. Projection was accurate and quick. Tn. Hyphæma was absorbed.

Right eye was quiet. Vision was $\frac{6}{6}$. Chamber was shallow. Pupil was circular and active. Tn. O. D. normal.

Emma L., aged 68, widow, pyorrhœa, fair health. Admitted July 17, 1917, under Mr. Flemming. No treatment. On admission the left eye was injected. There was a central corneal haze. The chamber was shallow. The pupil dilated and fixed. Lens opacities obscured the fundus. Vision equaled P. L. T. + 1.

July 17th left iridectomy was made under $CHCl_3$. The eye became infected and was eviscerated July 23d.

Discharged, August 13th. Right eye was quiet. Chamber was shallow. Pupil was active and circular. Vision was $\frac{6}{36}$; vision with a − 1.50 sph. equaled $\frac{6}{6}$. O. D. normal. Tn.

Phœbe E., aged 49, married, general health good. Admitted April 6, 1916, under Mr. Hudson. No treatment. On admission the right cornea was hazy and very œdematous. The chamber was shallow, and the pupil dilated and inactive. Vision equaled $\frac{2}{60}$. T. + 1.

April 6th right iridectomy was made under $CHCl_3$.

April 17th, discharged. Cornea was bright. Iris pillars were free. Vitreous was hazy. O. D. not cupped. A few small hemorrhages were seen near the disk. Vision with a − 3.00 sph. and a + 6.00 cyl. axis H. equaled $\frac{6}{12}$. Left eye was quiet. Vision was $\frac{6}{6}$ unaided. Shallow chamber. T. with Schiotz was 25*mm* Hg.

Annie F., aged 63, widow, good health. Admitted, August 4, 1917, under Mr. Spicer. Right eye was first inflamed in July, 1917, while in a hospital for an injury to head. No eye treatment. On admission to Moorfields Hospital the right eye showed a condition of acute congestive glaucoma. Vision equaled fingers. Fundus was obscured. T. + 1.

August 5th a right paracentesis was done under $CHCl_3$.

August 7th an iridectomy was made under $CHCl_3$.

August 24th, discharged. Right cornea was bright. Iris pillars were free. Vitreous slightly hazy. Vision equaled $\frac{6}{24}$. Tn.

Left quiet. Vision $\frac{6}{6}$. Chamber shallow. Tn.

Elizabeth G., aged 52, married, good health. Admitted August 14, 1917, under Mr. Spicer. Right eye was first inflamed August 7, 1917. No treatment. On admission the eye showed a condition of acute congestive glaucoma. Vision equaled fingers. T. + 2.

August 15th an iridectomy was made under $CHCl_3$.

August 24th, discharged. Right cornea was bright. Iris pillars were free. Vitreous was hazy. Vision equaled $\frac{4}{60}$. Tn. O. D. was not cupped.

Left eye showed a condition of absolute glaucoma. Vision equaled no P. L. T. + 2.

May, 1919, R. V. equaled $\frac{6}{12}$.

Harriet S., aged 50, single, good health. Admitted, September 10, 1916, under Mr. Lawford. No treatment.

Present attack began two days before she was admitted On admission the right cornea was hazy, the chamber shallow, and the pupil was dilated. Vision equaled fingers. T. was + 1.

September 12th an iridectomy was made under $CHCl_3$ and ether.

October 4th, discharged. Right cornea was hazy. Iris pillars were free. O. D. was not cupped. Vision equaled $\frac{6}{36}$. Tn.

Left eye. Anterior chamber was shallow. Pupil small (eserine); vision was $\frac{6}{12}$. O. D. was normal. Tn.

Eliza B., aged 69, widow, good health. Admitted September 8, 1917, under Mr. Lawford. In April, 1917, first saw halos, but the right eye never was painful until September 3d, five days before admission. No treatment. On admission the right eye showed a state of acute congestive glaucoma. The fundus was obscured and the vision equaled fingers. T. was + 2.

September 12th an iridectomy was done under novocaine.

October 3d, discharged. Right cornea was almost clear. Iris pillars were free. Vitreous was hazy. O. D. was not cupped. Tn. Vision equaled $\frac{6}{36}$. Nasal field was not contracted.

Left eye. Chamber was shallow. Vision equaled $\frac{6}{6}$. Full field. Tn.

September 5, 1918. R. V. equaled $\frac{6}{9}$.

Annie C., aged 59, married, myxœdema. Admitted, September 28, 1917, under Mr. Lawford. No treatment. Present attack began twenty-four hours before she was admitted. On admission the left eye was not very painful. The cornea was steamy and insensitive. The chamber was shallow. The pupil was dilated and inactive. Vision equaled fingers. T. + 1.

September 29th an iridectomy was made under novocaine.

October 20th, discharged. Left quiet. Iris pillars were free. Vitreous was hazy. Vision equaled $\frac{4}{60}$. Tn. O. D. was cupped.

Right eye. Chamber was shallow. Vision equaled $\frac{6}{9}$. O. D. was normal. Tn.

Jane B., aged 72, married, subject to rheumatism. Admitted, August 17, 1917, under Mr. Lawford. July 29, 1917, patient had her first attack of pain in right eye, accompanied by several attacks of emesis. Treated by her family physician with "drops." Was given eserine August 15th at a London hospital. On admission to Moorfields Hospital the right eye showed a state of acute congestive glaucoma. Vision equaled $\frac{3}{60}$. T. + 1.

August 18th an iridectomy was made under $CHCl_3$.

September 5th discharged. Iris pillars were free. Vitreous was hazy. Tn.

Left eye. Chamber was shallow. Vision was $\frac{6}{9}$. O. D. was normal. Tn. Field was full.

September 21, 1918, R. V. equaled $\frac{6}{6}$. O. D. was normal. The nasal field was contracted between the vertical and sixtieth meridians about 10 degrees.

Elizabeth O., aged 71, single, good health. Admitted, July 11, 1917, under Mr. Lawford. First saw halos in May, 1917. Present attack began July 9th. No treatment. On admission the right eye showed a state of acute congestive glaucoma. Vision equaled fingers. T. was + 2.

July 14th an iridectomy was made under $CHCl_3$.

August 1st, discharged. The iris pillars were free. Vitreous haze obscured the fundus details. Vision equaled $\frac{6}{60}$. Tn.

Left eye. Operated for subacute glaucoma at Moorfields Hospital, February 10, 1915. Vision equaled $\frac{4}{60}$. O. D. was cupped.

Joseph W., aged 68, married, good health. Admitted October 22, 1917, under Mr. Hepburn.

October 14th the right eye was red, but not very painful. No treatment. On admission the right cornea was hazy, the chamber shallow, and the pupil dilated. Vision was $\frac{6}{60}$. The fundus was apparently normal. T. + 1.

October 23d an iridectomy was made under $CHCl_3$.

October 25th patient was frightened during an air raid and got up from his bed. In the morning the nasal pillar was prolapsed.

Iris pillar was replaced with a repositor and remained in place.

November 1st discharged. Right eye was quiet. Iris pillars were free. Vision was $\frac{6}{18}$. Tn. O. D. not cupped.

Left eye. Chamber was shallow. Vision was $\frac{6}{9}$. O. D. was normal. Tn. Nasal field was contracted about 30 degrees, except below.

Sarah K., aged 61, widow, good health. Admitted, August 7, 1917, under Mr. Fisher, with subacute glaucoma in left eye. On admission the left eye showed the cornea was hazy, the chamber shallow, and the pupil dilated. Vision was reduced to fingers. T. was + 2. Fundus was obscured.

August 10th an iridectomy was made under $CHCl_3$ down and out.

August 28th, discharged. Iris pillars were free. Vitreous was hazy. Vision was $\frac{6}{60}$. Tn. O. D. normal. Macular changes.

October 8th, readmitted on account of tension. The cornea was slightly hazy. Vision was $\frac{6}{60}$. O. D. was not visible.

October 9th left trephined under cocaine.

October 23d, discharged. Cornea was bright. Vision was $\frac{6}{60}$. O. D. was cupped. Good drainage. Tn.

Right eye showed old choroidal changes at the macula. Vision was $\frac{4}{60}$. Tn. O. D. was not cupped. The chamber was shallow.

Sarah N., aged 48, married, pyorrhœa, good health. Admitted, November 9, 1917, under Mr. Fisher. Right vision misty since May, 1917. No treatment. On admission the right eye showed a condition of subacute glaucoma. Vision equaled fingers. Fundus was obscured. T. + 1.

November 11th right was trephined under cocaine.

November 27th discharged. Anterior chamber was very shallow. Vision was $\frac{6}{36}$. Vitreous hazy. O. D. was cupped. Tn.

Left eye. The anterior chamber was shallow. Vision was $\frac{6}{9}$. O. D. was normal and the Tn. Full field.

William C., aged 57, married, good health. Admitted, November 5, 1917, under Mr. Collins with an attack of acute congestive glaucoma in each eye. Present attack began five days before admission. The attack in the left eye began twenty-four hours prior to admission and was accompanied by emesis. No treatment.

On admission the eyes showed acute congestive glaucoma. The vision in each was reduced to fingers. T. was + 1.

November 5th right and left were trephined under $CHCl_3$.

November 22d, discharged. Right eye was injected. Fundus obscured by the hazy vitreous. Vision equaled $\frac{2}{60}$. Tn. Drainage was not satisfactory. (Disk fell into anterior chamber.)

Left eye was quiet. The cornea was bright. Vision was $\frac{6}{24}$. O. D. not cupped. Full field. Tn.

Lavater W., aged 62, married, good health. Admitted December 10, 1917, under Mr. Collins with an attack of acute congestive glaucoma in the right eye of five days' duration. No treatment. Vision equaled shadows. T. was + 1.

December 10th right trephined—novocaine.

December 31st, discharged. Right was injected, and the cornea hazy. Vision equaled fingers. Lens opacity obscured the fundus. Tn.

Left eye was blind since October, 1917, the result of an injury.

Lydia H., aged 78, married, general health was not good. Admitted, October 18, 1916, under Mr. Collins. The right eye was occasionally painful for some time. During the summer of 1916 the sight was dim at times. No treatment prior to admission. The cornea was hazy, the chamber shallow, the pupil dilated and inactive. O. D. and fundus details were obscured. T. + 1.

October 19, 1916, right eye was trephined under cocaine.

October 28th a large detachment of choroid was seen at the temporal side. Also a small hemorrhage near the disk.

November 8th detachment was extending upward. The anterior chamber was very shallow. Vision with a + 4.00 sphere was $\frac{6}{36}$.

November 25th. Tn. No iritis. Atropine ordered and the tension was +, twenty-four hours later. No detachment of choroid seen. Atropine discontinued.

December 20th T. +. No keratitis punctata and no synechiæ were seen. Vision equaled $\frac{1}{60}$.

December 21, 1916, a second trephine was necessary.

Discharged, January 8th. Cornea bright. No deposits on posterior surface. No detachment seen. Vision equaled hand movements. Hyphæma, and blood in pupil area obscured the fundus.

Left eye was blind from glaucoma. Vision equaled no P. L.

Eliza S., aged 61, married, good health. Admitted January 11, 1917, under Mr. Hudson. December 21, 1916, the right vision failed over night. The left vision failed a few days later. No treatment.

On admission both eyes were in a state of acute congestive glaucoma. The vision equaled fingers. T. was + 2.

January 11th an iridectomy was made on each eye under $CHCl_3$.

January 25th discharged. The corneæ were bright in each eye. The iris pillars were free. No keratitis punctata was seen and both lenses were uninjured. In each eye the vitreous was hazy. Both disks were slightly cupped. Vision in each was $\frac{6}{36}$. Tn. June 30, 1917, R. and L. V. equaled $\frac{6}{9}$. Tn.

Sarah M., aged 72, widow, health fairly good. Admitted April 23, 1917, under Mr. Collins. April 17th the right eye became inflamed and painful. No treatment prior to admission.

April 23d the right eye was slightly injected. The pupil was oval and inactive. Central lens opacity. Vision was $\frac{6}{60}$. Fundus details obscured. T. + 1. Nasal field was contracted one half. Saw halos the first time in 1916.

April 24th right trephined under novocaine.

Discharged May 10th. R. V. was $\frac{6}{18}$. Central lens opacity. O. D. was cupped. Drainage was good. Tn.

Left eye had chronic glaucoma. Vision equaled hand movements. Lens opacity obscured the fundus. T. + 1. Was not painful. Eye was quiet.

Bessie W., aged 45, single, good health. Admitted December 25, 1915, under Mr. Lawford. Was under treatment by her doctor who gave "drops" for the pain. On admission the left eye showed a condition of acute congestive glaucoma. Vision equaled hand movements. T. + 2.

December 25th an iridectomy was made under $CHCl_3$ and ether.

January 8, 1916, discharged. Left cornea was bright. Iris pillars were free. O. D. was not cupped. Vision was $\frac{6}{24}$. Tn.

Right eye. Vision was $\frac{6}{6}$. Shallow chamber. Tn.

George P., aged 79, married, laborer, fair health. Admitted July 25, 1916, under Mr. Parsons. July 4, 1916, the right eye first became inflamed. No treatment. On admission the eye showed a condition of subacute glaucoma. Vision equaled $\frac{4}{60}$. T. +.

July 26th right trephined under novocaine.

August 9th discharged. Right showed lens opacity (nucleus). O. D. not cupped. Vision equaled fingers. Tn. Good drainage.

Left eye. Vision was $\frac{6}{6}$. Lens opacities. Full field. Tn. O. D. was not cupped.

George R., aged 48, blacksmith, good health. Admitted September 20, 1916, under Mr. Parsons. Left eye was first inflamed and painful twenty-four hours before admission. On admission the left eye showed a state of acute congestive glaucoma. Vision equaled $\frac{6}{60}$. T. + 1. Fundus details were obscured.

September 27th left Tn. Patient refused an operation. Discharged.

November 29th readmitted on account of a second attack in left eye. Patient had omitted to use his eserine drops as the eye felt all right. On admission the left eye showed a severe glaucomatous attack. The vision equaled hand movements. The pupil was widely dilated and the pain was very intense.

December 6th left iridectomy under cocaine.

December 15th discharged. Left eye was quiet. Iris pillars were free. Lens clear. Vision was $\frac{6}{6}$. Tn.

Right eye. Operated for acute glaucoma in 1914 at Moorfields Hospital. Vision equaled $\frac{6}{6}$. O. D. normal. Tn.

Edward F., aged 71, salesman, fair health. Admitted March 16, 1916, under Mr. Hudson. Left painful since March 9th. On admission the left eye showed a state of subacute glaucoma. Vision equaled fingers. T. was + 2. Fundus obscured.

The right eye showed a state of chronic glaucoma. Vision equaled P. L. T. + 2.

March 16th right and left were trephined under cocaine.

Discharged April 11th. Left cornea showed much striated opacity. O. D. not cupped very much, color was good. Tn. Vitreous hazy. Vision equaled $\frac{6}{60}$.

Mary R., aged 68, widow, fair health. Admitted April 10, 1916, under Mr. Hudson. Was treated for "iritis" with atropine drops. In February patient was ill with influenza. Present attack began a few days before admission. On admission both eyes showed a state of subacute glaucoma. The vision in each was less than $\frac{4}{60}$.

April 11th a right and left iridectomy was made under $CHCl_3$ and ether.

May 2d discharged. Left choroid detached. Vision was shadows. Tn. Right inner pillar caught up. O. D. cupped. Vision was reduced to fingers. Tn.

Emma T., aged 60, married, good health. Admitted May 1, 1916, under Mr. Hudson. Right vision failed in April, 1916, during an attack of influenza. On admission the right eye showed a condition of subacute glaucoma. Vision equaled fingers. T. + 1.

May 1st right paracentesis under cocaine.

May 4th right trephined under cocaine and novocaine.

May 15th discharged. Right quiet. Vision was $\frac{6}{18}$. Tn. Nasal field was contracted and blind spot enlarged.

Left quiet. Chamber was shallow. Vision equaled $\frac{6}{12}$. Tn. O. D. was not cupped. Full field.

Stephen P., aged 60, married, fair health. Admitted January 1, 1916, under Mr. Spicer. Right vision was misty in 1912 and since at intervals. On admission the right eye was in a state of acute congestive glaucoma. Vision was reduced to fingers and the T. was + 1.

January 7th an iridectomy was made under $CHCl_3$.

January 20th discharged. R. V. equaled $\frac{6}{9}$. Pillars were free. Tn.

Left cornea was bright. Pupil contracted (eserine). Tn. Vision was $\frac{6}{9}$.

Arthur G., aged 51, married, good health. Admitted June 29, 1916, under Mr. Hudson. Left eye was first inflamed twenty-four hours before admission. No treatment. On admission the left eye showed a state of acute congestive glaucoma. Vision equaled fingers. T. was + 1.

June 30th an iridectomy was done under $CHCl_3$.

July 8th discharged. Cornea was bright. Iris pillars were free. Vision equaled $\frac{6}{18}$. O. D. was not cupped. Tn.

Right eye was operated for glaucoma at Moorfields Hospital in 1914. Vision was $\frac{6}{12}$. O. D. was not cupped. Tn.

Sarah C., aged 49, married, good health. Admitted December 7, 1916, under Mr. Spicer. Right eye was first inflamed and painful November 29, 1916. No treatment. On admission the right eye showed a state of acute congestive glaucoma. Vision equaled fingers. T. was + 2.

December 8, 1916, an iridectomy was made under $CHCl_3$.

December 24th discharged. Right was quiet. Iris pillars were free. Anterior lens opacities. O. D. not cupped. Vision was $\frac{6}{60}$. Tn.

Left eye. Had chronic glaucoma. Vision equaled no P. L. T. + 2. May 4, 1917. R. V. equaled $\frac{6}{18}$.

Emma R., aged 63, single, good health. Admitted January 4, 1916, under Mr. Flemming. Taken direct to theater and had an iridectomy on left eye under $CHCl_3$.

On admission the eye showed a state of acute congestive glaucoma. Vision equaled fingers. Fundus details obscured but O. D. was not cupped. T. was + 1.

January 19th discharged. Cornea was bright. Iris pillars were free. Vitreous opacities. Posterior polar cataract. O. D. not cupped. Vision with a + 2.00 cyl. was $\frac{6}{36}$.

Right quiet. Vision was $\frac{6}{18}$. Posterior polar cataract. T. +. O. D. was not cupped.

Evelyn E., aged 45, married, good health. Admitted November 14, 1916, under Mr. Flemming. No treatment. The left eye showed a state of acute congestive glaucoma on admission. Vision equaled fingers. T. + 2.

November 15th an iridectomy was made—$CHCl_3$.

November 23d vision was $\frac{6}{36}$. Much striate corneal opacity.

November 30th the T. was +. Cornea was œdematous.

December 1st left paracentesis was necessary, under novocaine.

December 2d left anterior sclerotomy under $CHCl_3$. Several recent hemorrhages were seen about the disk, which was slightly cupped. Vision with a + 4.00 cyl. Vision equaled $\frac{6}{12}$. Tn.

December 22d discharged. Cornea was slightly œdematous above. No keratitis punctata or synechiæ present. Iris pillars were both drawn up slightly. T. +. Vision equaled $\frac{6}{12}$ with the same correction. O. D. slightly cupped. Many small hemorrhages about the disk.

Right eye trephined May 4, 1917.

July, 1919. R. V. was $\frac{6}{9}$. O. D. was normal. L. V. was $\frac{6}{12}$ with a + 4.50 cyl. Tn. O. D. was a good color.

John K., aged 70, married, fair health. Admitted February 4, 1916, under Mr. Hepburn. Left was first inflamed in January, 1916. No treatment. On admission the left eye showed a state of acute congestive glaucoma. Vision equaled fingers. T. was + 2.

February 5th an iridectomy was made under $CHCl_3$.

February 23d discharged. Left eye was slightly injected. Iris-pillars were free. Much lens opacity. Fundus was obscured. Vision equaled $\frac{2}{60}$. Tn.

Right eye was operated for glaucoma at Moorfields. March 5, 1912 (iridectomy). Vision equaled $\frac{6}{24}$. O. D. was cupped.

William C., aged 65, married, fair health. Admitted May 10, 1916, under Mr. Hepburn with acute congestive glaucoma in right eye of two days duration. No treatment. Vision equaled fingers. T. was + 2.

May 11th an iridectomy was made under $CHCl_3$.

April 18th choroid was detached. Vitreous opacities.

May 1st no detachment of choroid was seen. Macular changes were seen, however.

May 5th discharged. Right was quiet. No detachment present. Iris pillars were free. Vitreous much clearer. Vision was $\frac{6}{36}$. O. D. was slightly cupped. No hemorrhages seen. Tn.

Left eye. Quiet. Vitreous opacities. No keratitis punctata. *Macular changes.* Vision equaled $\frac{6}{36}$. Vision with a + 3.00 sph. equaled $\frac{6}{12}$. O. D. was not cupped Tn.

March 10, 1918 left glaucoma iridectomy $CHCl_3$. L. V. on April 18, 1918, equaled $\frac{6}{18}$ with a + 2.00 sph. and a + 2.00 cyl. axis H. The left eye developed acute congestive glaucoma two days before admission accompanied by severe pain and vomiting.

Remarks: In the 87 patients admitted there were 103 eyes with acute or subacute glaucoma. The cases with chronic glaucoma in the other eye were merely mentioned with a note of the vision and condition of the optic nerve. The right eye was involved in 48 and the left in 55 cases. There were 24 males and 63 females.

Regarding the age; one case was 25, two were 31, twenty were between 40 and 50, twenty-one were between 50 and 60, thirty-seven between 60 and 70, fourteen between 70 and 80 and one between 80 and 90 years. A few of the cases were bilateral.

Influenza was present or preceded the attack in four cases, rheumatism in four, and three cases had pyorrhœa very badly. In two cases there was a history before the attack set in, and five cases showed a postoperative injury. A hyphæma developed in 8 cases. In only one case was the iris pillar prolapsed and it remained in place after the use of an iris repositor,

The cases admitted without treatment numbered 61. Boric lotion was used by 13, atropine by 4, and eserine by 8 of the cases. Previous attacks were noted in 74 of the cases, while 26 came to the hospital during or just after the first attack, 65 patients saw halos and 46 vomited with their attacks. A few were nauseated, but did not vomit.

In Stock's cases atropine was used on the second day. A mild iritis was seen more frequently than after iridectomy. Stock advocated the removal of a hyphæma at the time of operation to aid healing. In all his cases he reduced the tension to 26 or less except in one. He did not encounter a single case of expulsive hemorrhage, loss of vitreous, or glaucoma fulminans. In 4 cases he was able to compare the tension after iridectomy with that of trephining, in the same or the fellow eye. In case 1, the tension after iridectomy was 33, after trephining 18. In case 2, after iridectomy 26, after trephining 22. In case 3 the tension after iridectomy was 95, after trephining 18 and in case 4, the tension was 26 as compared with 18 after trephining.

Stock included as acute all cases with a history of clouded vision or pain or halos.

Acute congestive glaucoma was present in 69 of the cases and subacute in the balance. Of the 63 iridectomies, the iris pillars were drawn up to the wound in 4, not including the one that prolapsed, mentioned above. In the 35 trephined cases, the disk fell into the anterior chamber in 1, without causing symptoms of iridocyclitis. A Herbert's sclerotomy was performed in 1 case and 1 case refused operation.

The fundus was obscured by lens opacities in 7 cases, while vitreous opacities obscured the details in 11 cases. In many of the latter, however, the fundus details were seen at a later date and no pathological cupping was noted. In 1 case the eye converged 20 degrees.

In 2 cases the choroid was detached, but only for a few days. Retinal detachment occurred in 2 cases and persisted. Retinal hemorrhages were present in at least 3 of the cases, and in each, near the optic disk. In 16 cases the optic disk showed cupping. No cupping was seen in 75, while in the remaining cases the fundus was obscured. Vitreous opacities were seen in 33 of the cases, although in many, the opacities were fine and disappeared later.

The nasal field in 11 cases was contracted from 5 to 30 degrees. Two cases showed a concentric contraction, one of 10 and the other of 20 degrees. In 4 cases no contraction was present, while in the remaining cases no field was obtained owing to the reduced vision at the time of entrance to hospital. I have not been able to secure the figures, regarding the fields of those cases, that had their fields charted since operation.

The lowest tension prior to operation, recorded with the Schiotz tenometer, registered 25*mm Hg* and the highest 42, although in many of the operated cases the tension was undoubtedly much higher than this figure. In 9 cases the fellow eye had been operated for chronic glaucoma and in 3 for acute at some previous period.

In a review of the literature of the past ten years, covering the period since the modern decompression operations were introduced by LaGrange and Elliot, I have considered only those authors, who have reported ten or more cases. While many oculists have had this number or more, they have not published the details of their cases, so that a comparison could be made, and one has to confine his comparisons, with the cases reported by Stock and Meller. In a recent letter from Colonel Elliot asking him for his statistics to compare with other authors and those of the Moorfields Hospital, he was unable to furnish the same.

The following table gives a comparison of Stock, Meller, and the author, showing the visions on discharge, with the cases that were improved, remained stationary, or became worse. Those cases included under the title of author were operated by the following ophthalmic surgeons—Treacher Collins, Holmes Spicer, J. B. Lawford, Percy Flemming, J. Herbert Parsons, J. Herbert Fisher, Claude Worth, Malcolm Hepburn, A. C. Hudson, and Foster Moore.

AUTHOR.				S. M. A.			S. M. A.			S. M. A.		
CASES.			VISION.	IMPROVED.			STATIONARY.			WORSE.		
Stock.	*Meller.*	*Author.*										
4	0	10	Lt. Perc. to Hand Mov.	0	0	0	4	0	3	0	0	7
3	4	12	Hand Mov. to $\frac{1}{60}$	1	3	4	2	0	5	0	1	3
2	1	21	$\frac{1}{60}$ to $\frac{6}{60}$	2	0	18	0	0	3	0	1	0
2	0	31	$\frac{6}{60}$ to $\frac{6}{18}$	1	0	31	1	0	0	0	0	0
3	0	9	$\frac{6}{18}$ to $\frac{6}{12}$	1	0	9	1	0	0	1	0	0
0	3	11	$\frac{6}{12}$ to $\frac{6}{9}$	0	3	11	0	0	0	0	0	0
8	2	9	$\frac{6}{9}$ to $\frac{6}{6}$	3	0	0	2	2	3	3	0	0
22	10	103		8	6	73	10	2	14	4	2	10

In conclusion the author wishes to thank the entire hospital staff for the use of their cases.

REFERENCES.

STOCK (*K. M. f. A.*), vol. l., No. 11, p. 462, 1912.
MELLER (*K. M. f. A.*), vol. xlvii., No. 11, p. 641, 1909.

THE OPTICS OF THE CORNEA.[1]

By GEORGE W. VANDEGRIFT, M.A., M.D., New York.

IN this paper, necessarily brief, no detailed discussion of the optical phenomena displayed by the cornea is possible. I have attempted to deal succinctly with a few of the refractive, reflective, and diffractive manifestations which are not only of theoretic interest, but also are the fundamental facts upon which ophthalmic optics, in so far as the cornea is involved, are based. It may also, by its very superficiality, create an interest in us to delve more deeply into the generalizations upon which our practice proceeds, and which in our every day haste we are apt to neglect.

The cornea is a transparent optical system consisting of two spherical surfaces and three isotropic media; the air, the corneal core, and the aqueous humour. As the radii of curvature of the surfaces are measured in the same direction as the rays of incidence they are positive and the surfaces are convex.

The anterior surface of the cornea may be divided into two portions, the central lying in front of the aperture of the iris, and the peripheral behind which the iris is suspended diaphragmatically. These two areas thus divided by their orientation differ markedly from each other in their optic manifestations. The central area, essential to the visual function, has an approximate width of 4*mm* horizontally and a trifle less vertically, and corresponds fairly with the average pupillary diameter. The central zone rarely exceeds this measurement but the pupillary width frequently varies up to 6*mm* under which exigency the peripheral area produces many optical obstructions to distinct vision, such as spherical aberration, increased size and distortion of diffusion circles and of astigmatic focal lines. The central area is the section of a sphere, or if astigmia be present, a combination of curvatures whose principal meridians at right angles to each other are arcs of two circles of constant though unequal radii. The peripheral area, in contra-distinction, being utilized adventitiously only in the visual act, does not require regularity of curvature and is found in the majority of cases to have a rapidly and continuously decreasing flexure from the border of the central area to the corneoscleral margin where it may become a plane surface or slightly concave.

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[1] Read before Section on Ophthalmology, New York Academy of Medicine, March 15, 1920.

Of the central area only therefore, is a radius of curvature obtainable, and reviewing the results obtained by many experimenters from Helmholtz to the present day we find 7.75*mm* as a fairly constant average. This however does not imply that a longer or shorter radius produces refractive hypermetropia or myopia for the other optical factors so vary, as axial length and refractive indices, that emmetropia, which depends primarily upon a just proportion of all refractive parts, results.

In a series of fifty eyes examined by means of the Javal-Schiotz ophthalmometer I have been able to determine approximately the outline of the central visual zone. Dividing the arc of the ophthalmometer into spaces of 5 degrees each, and having the patient fix in turn each 5-degree line, a point of intersection is found at which the curvature from a constant reading of the entire central area changes suddenly as the peripheral zone is reached. This may be ascertained both horizontally and vertically in a manner similar to that of determining astigmia ordinarily except that the patient instead of fixing his gaze down the telescope fixes on successive marks on the arc. Such determinations are of course liable to error chiefly on account of the difficulty experienced by the patient fixing the same point in space as the arc is rotated.

The average width was found to be about 35 degrees horizontally, and 30 degrees vertically which is slightly larger than found by Erikson and quoted in the *American Encylopedia of Ophthalmology* vol. 13.

In a similar manner the peripheral zone was analyzed and the curvature found not only to change abruptly at the border of the peripheral zone, but to increasingly change horizontally and vertically as far to the external periphery as the ophthalmometer would furnish distinct readings.

(*a*) In seven cases in which the central zone was non-astigmatic a 0.50 to 1 D of astigmia developed at about 15° which in common parlance was with the rule, that is, a decrease of horizontal curvature.

(*b*) In thirty-one cases of hypermetropic astigmia with the rule an increase of 1 to 2 D developed.

(*c*) In eight cases of myopic astigmia with the rule the astigmia increased 0.50 to 1 D.

(*d*) In one case of hypermetropic astigmia 0.50 D with the rule the astigmia in the peripheral zone became against the rule 2 D, an increase of curvature.

(*e*) In one case of myopic astigmia with the rule 1 D the periphery displayed no astigmia.

(*f*) In two cases of myopic astigmia of 1 to 2 D against the rule one displayed no astigmia and the other 0.50 D of similar astigmia 15.

In all cases, except (e) the change of curvature that began at about 15° from the fixation line persisted increasingly to the periphery.

The refractive power of the central zone of the anterior corneal surface is ascertained easily when the radius of curvature is known, for the refractive index of the corneal core may be accepted as 1.376 as compared to air which is 1. Refractive power is expressed by the formula $\frac{n' - n}{r}$ in which n′ is the index of the corneal substance, n the index of air, and r the radius of curvature. With r having the value of 7.75*mm* the refractive power is 48.5 D. As the refractive indices are constant the refractivity depends upon the radius of curvature which, while having the average 7.75, may vary from 7.2 to 8.6*mm*. In children the radii of curvature of the cornea as well as of the lens are slightly under the average for the adult, but not in proportion to the axial shortening of the globe; so that while the refractive power of the infant's eye is greater than that of the adult it is due largely to the shortness of the optic axis; the shortening of the radii of curvature being counterbalanced by the smaller refractive index of the lens.

The peripheral zone of the anterior corneal surface approximates a parabola in form and the radii continuously vary. This may be demonstrated by the ophthalmometer as the images of the mires, which at the central zone are rectangular, continuously elongate within the peripheral zone. On account of its parabolic form the peripheral zone produces a positive spherical aberration which is prevalent in nearly all the peripheral regions from the external boundaries almost up to the central zone, and under certain exigencies, such as enlargement of the pupil, natural or artificial, and aphakia, interferes with distinct vision. Under normal conditions a slight aberration is corrected by the lens which has an increasing refractivity from the periphery to the center. Spherical aberration, however, is not entirely due to the parabolic form of the peripheral zone, for even if the entire cornea were the section of a sphere, unless aplanatic, aberration effects would occur, for exact punctual imagery is obtainable in a plane mirror only, and approximately under other conditions only when the incident rays are paraxial.

The following case will demonstrate the practical aspects of spherical aberration:

> Mr. X, age 31, has experienced as long as he can remember, without relief, defective vision and asthenopia. Under excessive illumination he develops a marked photopsia attended by muscæ volitantes, which disappear under low illumination.
>
> Right eye, uncorrected vision $\frac{20}{50}$, left eye, uncorrected vision $\frac{20}{100}$. Cycloplegiac and post cycloplegiac correction with O. D. cyl. − 3 axis 30 and O. S. cyl. − 3 axis 155 furnishes $\frac{20}{40}$ and $\frac{20}{70}$ vision. Tension normal.
>
> Retinoscopy displays a marked scissor movement in both eyes in the axis of the defective curvature. All deep ocular parts normal. The corneæ by oblique illumination appear normal, free of scars or of any tendency to keratoconus. A curious phenomenon, however, occurs with the ophthalmometer. With the mires properly adjusted for the astigmatic reading only a central portion of the combined images appears undistorted while the peripheral parts are markedly elongated.
>
> The symptoms similar to those produced by conical cornea undoubtedly are due to the fact that the central visual area of each cornea is abnormally small, approximately 2*mm*, while the average pupillary width is 5*mm*, allowing severe

> aberration effects to occur under high illumination. The vision was finally tested, with the correcting cylinders worn, through a *2mm* aperture, and that the above reasoning was accurate was proven by the fact that $\frac{20}{20}$ vision was accomplished in each eye. The same result was obtained when the pupils were contracted with pilocarpine.

Data concerning the posterior surface of the cornea are difficult to obtain by experimentation as the ophthalmometer upon which we rely largely for determinations measures the anterior surface alone. It is known, however, to be more nearly the section of a sphere and to have an average radius of approximately 6.8*mm*, which, the refractive index of the aqueous being 1.336, gives a refractive power of − 5.8 D. As the index of refraction of the corneal core is greater than air the anterior surface is refractively convergent, but as the index of the aqueous is less than that of the corneal medium the posterior surface is refractively divergent. The posterior surface therefore reduces slightly the refractive power of the anterior surface.

In calculating the entire corneal refractivity the reduced interval between the two surfaces adds an inappreciable quantity (0.1 D.) to the sum of the two surfaces. The corneal core is of interest optically in the study of diffractive phenomena. This heterogeneous refractive medium may produce halos about the sources of illumination in a manner similar to those produced by tears and discharges in the conjunctival sac. The corneal epithelial and endothelial cells and the cells in the lymph channels obstruct the light rays as they return from the retina, and by unequal diffraction of the light constituents produce spectral halos and rings particularly when the sources of illumination are projected against dark backgrounds. Similarly in glaucoma the penetration of fluids into the posterior corneal layers produces by diffraction the rings and halos pathognomonic of the disease.

When to the corneal refractivity we combine that of the lens, which in an emmetropic eye of 24*mm* axial length, under complete accommodative relaxation, is + 19.110 D., computed by means of Helmholtz's constants, we find the entire refractivity of the eye to be + 58.64 D. The anterior and posterior principal focal lengths from the anterior corneal vertex are

-15.707 and $+24.387$*mm*. By these figures an emmetropic eye has its posterior principal focus 0.387*mm* behind the fovea and is hypermetropic approximately 1 D. and must exert some accommodative power to achieve distinct vision at 6 meters.

From formulæ derived from the optical constants the positions of the cardinal points are obtainable, upon which depend calculations respecting diffusion circles, size of retinal images, and other important ocular manifestations too numerous to mention here. A few brief words may be inserted concerning the effects upon these points produced by the process of accommodation. By this act their positions are altered along the optic axis; the focal lengths are shortened, the refractive power increased, and the nodal and principal points drawn nearer the posterior surface of the cornea. If the near point is approximately 10*cm* from the corneal vertex the focal lengths are reduced to $+14$ and -18*mm* and the refractivity increased to 70 D. The principal points however for practical purposes are unchanged for they are moved by this maximum effort of accommodation less than 0.5*mm*. The nodal points are changed more materially as they are much farther from the corneal vertex than the principal points. The principal points, therefore, are the most practical points of reference for the determination of the far and near points, and for the measurement and comparison of retinal images. If we consider the eye reduced to the schematic eye of Donders, consisting of a spherical surface of $\frac{4}{3}$ refractive index and 5*mm* radius, the two principal points coincide and lie at the vertex of this simplified cornea, and the primary focal point from this is 15*mm*. The principal point being independent of the accommodative act may be used as the vertex of the visual angle which becomes the measure of the size of retinal images, so that objects having the same apparent size at the principal point have the same sized retinal images irrespective of the accommodative act. But when the anterior focal point is taken as the vertex of the visual angle the retinal image is proportional to this angle for a given value of refractive power. But as the focal angle is independent, approximately, of the ametropia it serves as a comparison of the apparent size of objects perceived by eyes in various phases of refractivity or accommodation.

A discussion of corneal refraction would not be complete without a mention at least of astigmia. An astigmatic cornea may be considered a pair of crossed cylinders or a sphero-cylinder in which the curvatures are of varying refractivity in different meridians. The normal sections of a sphere are great circles of a sphere and of equal curvature. Their curvatures, however, through a point on the surface may vary from section to section, and if a plane containing the normal is revolved around this normal as an axis one arc will have the greatest and another, at 90°, the least curvature. The sections of greatest and least curvature are always in two perpendicular planes which are the principal sections of the surface at a particular point. The principal meridians of the astigmatic cornea are therefore usually at right angles to each other and may occupy any positions on the circumference of a circle mutually perpendicular. A fundamental law of such mutually perpendicular sections is that the algebraic sum of the refractive powers is constant and equal to the maximum refractivity. A narrow homocentric bundle of incident rays refracted by an astigmatic cornea, represented by a pair of crossed cylinders or a sphero-cylinder, is rendered heterocentric by the unequal curvatures, and punctual imagery is impossible. If the pupillary aperture is small, centered, and at right angles to the optic axis the transverse sections of each astigmatic bundle will be an ellipse, which becoming narrower collapses finally into its major axis. Each of these is the rendezvous of the unequally refracted bundles of light rays, the image line or the focal line of the cylindrical surface whose meridian of curvature is at right angles to it. The distance between the focal lines, the interval of Sturm, is the astigmatic measure. Somewhere between these focal lines, where the refracted rays are equally convergent and divergent, a circle of least confusion is formed.

In common parlance astigmia is frequently denoted by the terms "with" and "against the rule," and by "direct" and "inverse," which are both confusing and inaccurate in the light of freshly accumulated statistics. More accurate and scientific it is to specify an astigmatic error simply by its nature, myopic or hypermetropic, and by the axis of the defective curvature.

The form of the retinal image produced by an astigmatic cornea, whether the defective curvature is horizontal, vertical, or oblique, is not difficult to construct by placing an imaginary retina at various points on the optic axis. These retinal images are distinctly different from those formed by axial ametropia for in the latter the matter is one of size and definition, while in the former it is one of angular distortion, for the image formed by the defective curvature is larger (hypermetropic astigmia) or smaller (myopic astigmia) than that formed by the opposite curvature. Nor does the wearing of the proper correcting cylinder remove the difficulty fully, for when placed at the anterior focal point a cylinder lens defines the image, but does not affect its size, a result that can be attained only by placing the lens in direct contact with the cornea. It is for this reason that even after proper correction with spectacles patients may continue to complain of image distortion or more rarely of monocular diplopia symptoms, which, however, usually are transient as the astigmatic error is slight compared with the entire ocular refractivity.

When astigmia is considered binocularly the law of corresponding retinal points intrudes for if the astigmia is asymmetric and particularly asymmetrically oblique the images fall upon dissimilar retinal parts, for each image is displaced toward the meridian of greatest curvature. Under such an exigency binocular diplopia may result unless correcting cylinders are worn. Without such correction diplopia must be overcome by sectional ciliary action, which is doubtful, or by exertion of the fusion power through contraction of the oblique muscles rotating the eyes about the anterior-posterior axis, maintaining binocular single vision.

The reflective powers of the cornea are intimately associated with its refractive functions, and are of interest in the formation of the Purkinje-Sanson reflexes, the mathematical calculations of which are of fundamental importance in determining the curvatures and the positions of the refracting surfaces. The reflex from the anterior corneal surface occupies the apex of the visual fixation line so that perimetrically or by means of the ophthalmophakometer the value of the angle α is determined, as well as the positions and centering of the internal surfaces, when combined with calculations concerning the lenticular reflexes. The posterior corneal reflex is produced by refraction by the anterior surface and reflection by the posterior and with the unaided eye is observed with great difficulty, for the loss here by reflection is no more than 0.02% of the principal bundle of rays while that from the anterior surface is approximately 2.5%. The two corneal reflexes occupy the pupillary plane with the posterior lenticular reflex, while the anterior lenticular reflex, produced by an equivalent thin convex mirror of approximately 15*mm* radius with its vertex 3*mm* from the anterior corneal surface, lies approximately 7*mm* behind the pupillary plane.

Closely connected with these calculations are those concerned with the pupillary image. When we illuminate an eye we see an apparent pupil and iris, the aerial virtual image belonging to the incident rays. This apparent pupil varies in individuals and in the same individual at different ages. The plane of the apparent iris is 0.6*mm* in front of the real plane and the pupillary width is apparently enlarged. By the same refractive process the posterior surface of the cornea is apparently advanced so that deposits that may be upon Descemet's membrane appear by oblique illumination to be in immediate contact with the anterior surface.

A CASE OF RECURRENT CHORIORETINITIS BROUGHT ABOUT BY A SERIES OF DIFFERENT ETIOLOGICAL FACTORS.[1]

By Prof. C. E. FINLAY, Havana, Cuba.

THE clinical history of the case which has given occasion to this paper is as follows:

CLINICAL HISTORY.

W. K., æt. 53, consulted me for the first time on July 24, 1912. He complained of loss of sight, which had gradually developed within the preceding three years, and on being questioned, gave a history of abuse of tobacco, which he had reduced for some short time prior to his visit. I found his eye grounds normal, the vision in each eye being $\frac{20}{50}$, with central scotomata for red and green with normal field limits. I suppressed tobacco entirely and prescribed KI and strychnia internally. By August 17th his vision had improved to $\frac{20}{30}$.

The patient consulted me again on January 7, 1914, on account of a relapse of his visual trouble, which he attributed to a partial return to his old bad habit. I could not discover any lesion in his fundi. His vision: $\frac{20}{70}$; he could not perceive green and presented central scotomata for red. I instituted the same treatment that had been efficient before, a slight improvement resulting.

On May 6, 1914, he returned with another relapse, occurring this time under faithful observance of tobacco abstinence. His fundi showed some dilatation of the retinal veins, some blurring of disk margins, and some loss of transparency at the maculæ. V. O. D.: $\frac{20}{70}$, V. O. S.: $\frac{20}{200}$. Some days later, V. O. D.: $\frac{20}{50}$, V. O. S. : $\frac{6}{200}$. Under a strict enforcement of the treatment which had previously been so effective a slight improvement was obtained but not to the same extent as before. On June 25, 1914, V. O. D. : $\frac{20}{40}$, V. O. S. : $\frac{20}{200}$; the right eye showing a central scotoma for red and green, the left eye no perception of red, green being only perceived in the extreme temporal field. Tn. in both eyes.

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[1] Read before the Sociedad de Estudios Clinicos of Havana on February 24, 1920.

I took advantage of the opportunity of the patient going to Philadelphia to refer him to Dr. de Schweinitz. He had him enter the hospital of the University of Pennsylvania, where his whole system was overhauled, the only defect discovered, outside his eyes, was a dilatation of his transverse colon to twice its normal size. In his eyes he found degenerative changes at the maculæ. He diagnosed a central chorioretinitis brought about by an autointoxication from fermentation of digestive products favored by intestinal stasis in the colon. The patient was given a plan of treatment directed against this. I saw him in April, 1915, on account of a change of glasses. Vision in each eye was $\frac{20}{40}$, the macular lesions being scarcely noticeable.

I lost sight of the patient till November, 1918. He told me his eyes had kept in pretty good shape till the preceding fall, when during a visit to New York, visual troubles, similar to his old ones had developed. He had consulted Dr. Cutler, of that city, who diagnosed a central chorioretinitis and in an X-ray investigation which he ordered an apical abscess was discovered in one of his teeth; this was extracted and an autogenous vaccine prepared and employed. A rapid improvement followed, his sight improving within a few days from $\frac{20}{70}$ to $\frac{20}{40}$. A relapse had occurred a few days prior to his visit to me. As his remaining teeth were sound and he no longer smoked, I had an X-ray taken of his intestines, which revealed great dilatation and sagging of transverse colon. His fundi showed degenerative changes at the maculæ; his vision: $\frac{20}{70}$. I had him use a belt to raise his fallen colon, made him regulate his diet, and in a couple of weeks his vision had improved to $\frac{20}{50}$ plus.

OBSERVATIONS.

The unique feature of this case is the successive production of the same ocular lesion by a multiplicity of causes; in the first two attacks by an intoxication with tobacco, in the next by an intoxication of intestinal origin, in the fourth by septic absorption from an apical tooth abscess, and in the last attack again by an intestinal autointoxication. The possibility of all the outbreaks being brought about by this latter cause can be excluded by the rapidity with which the visual disturbances responded to treatment not taking this into account in the other instances. To my mind this can only be explained by some local lesion affecting the macular regions of our patient affecting their metabolism or making their nutrition difficult under the slightest variation from normal of its vascular supply and especially susceptible to certain toxins or poisons, the disturbances being at first purely functional. Arteriosclerosis is most probably at the bottom of the whole process.

The case is also of interest in connection with the etiological factor in each individual outbreak, lending itself in each instance to a review of the status of our knowledge regarding them and to considerations as to how much light it may throw on some disputed points.

In connection with the tobacco attacks, we find the case as pronouncedly favoring the theory of the primary lesion in tobacco amblyopia being in the ganglion cells of the macula. Prior to 1882, ophthalmological literature is rich in considerations and descriptions of the clinical aspect of this affection, some authors advancing different hypotheses as to its pathogenesis. After Samelsohn's (1) first anatomical findings, which were subsequently confirmed by Nettleship (2) and Vossius (3) the disease was ascribed to an interstitial retrobulbar neuritis of the papillomacular bundle. The lesion was later thoroughly worked out by Uhthoff (4), who traced the bundle from the macula to the basal ganglia. These investigations seemed conclusive but the latest researches point to the lesions found in the optic nerve being secondary to changes in the ganglion cells of the macula (5). Our case gives clinical support to this latter view, it not being surprising that in the first attacks no ophthalmoscopic changes were discernible at the maculæ as possibly no actual lesion then existed, the trouble being purely functional or they may have been so little pronounced as to have escaped detection—the fact that they showed up later makes one or other of these possibilities probable. In cases of tobacco or alcohol amblyopia with a marked atrophy of the temporal quadrant of the disk (papillomacular bundle) with no visible changes at the macula it is perhaps possible to admit that the lesion be essentially a retrobulbar neuritis interstitial in character, but in cases like this where no such atrophy was apparent even after the appearance of ophthalmoscopic signs at the macula, this hypothesis is not tenable.

The production of a central retinochoroiditis as a result of an intestinal autointoxication agrees with the researches of de Schweinitz (6) and other observers and one of the attacks which he had the opportunity to observe was attributed to this origin after an exhaustive investigation at the Pennsylvania University Hospital. The results of the dietetic treatment instituted in the first attack and of the mechanical means employed to prevent intestinal stasis in the last attack I saw him in, bear this out. I did not have the opportunity to try with this patient the treatment recommended in such cases by J. G. Dwyer (7) but if I meet with a similar case I propose to give it a trial.

The production of a focal eye lesion by septic absorption from an apical tooth abscess in the attack treated by Dr. Cutler, of New York, is in line with the numerous cases reported since Hunter, Lang, Ulrich, and others called attention to this etiological factor in eye diseases of obscure origin (8) and is confirmed by the rapid improvement following the extraction of the guilty tooth.

LITERATURE.

1. SAMELSOHN. "Zur Kentniss der retrob. Neuritis." *Arch. f. Ophth.*, xxviii., 1882.
2. NETTLESHIP AND EDMUND. *Trans. Ophth. Soc. Un. Kingd.*, i.
3. VOSSIUS. "Ein Fall der beiders. centr. Skotom." *Arch. f. Ophth.*, xxviii., 3–211.
4. UHTHOFF. *Graefe Saemisch*, xi., 2a–12.
   Arch. f. Ophth., xxxii., 95–108.
   Arch. f. Ophth., xxxiii., 251–318.
5. NUEL. *Arch. d'Opht.*, Août, 1896.
   USHER AND DEAN. *Trans. Ophth. Soc. Un. Kingd.*, 1896, xvi., 275.
   HOLDEN. *Arch. of Ophth.*, xxviii., 2–125.
   BIRSCH-HIRSCHFELD. *Arch. f. Ophth.*, l., 1900.
   Arch. f. Ophth., li., 990.
   Arch. f. Ophth., lii., 2–588.
   COLLINS AND MAYOU. *Pathology and Bacteriology of the Eye*, 1912, 200.
7. DE SCHWEINITZ. *Arch. of Ophth.*, 1912.
   Ophth. Record, 1915.
8. DWYER. *Arch. of Ophth.*, xlvii., 3–261.
   Arch. of Ophth., xlviii., 4–344.
   HUNTER. *British Med. Journ.* July, 1900, and November, 1904.
   LANG. *Lancet.* May 17, 1913.
   ULRICH. *Journ. Am. Med. Assoc.* Nov. 6, 1915.

OCULAR ORIENTATION: A FUNCTION OF THE EYES. ITS IMPORTANCE IN OPHTHALMOLOGY; ITS DEPENDENCE ON THE MUSCULAR SYSTEM.

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ORIENTATION is a word that has come down to us from ancient lore, through the churches later, and was soon applied to an instinct of animals that could find their way home after much wandering, and is now taken up (first I think) by Fuchs, to describe the function of binocular vision in man.

It is upon this function we depend for the guidance of every movement we make, from carrying a fork to our mouths, to the aviation of the sky. It is responsible for our efficiency in every calling we follow, whether for pleasure or in earning our livelihood. It is our pilot in our sojourn, from the time we leave our mother's apron string, until Father Time cuts the swath that gathers us in.

It seems singular that we have not taken up this important function as an entity in ophthalmology, and sought out the attributes belonging to it in health and disease, and discovered tests to learn its abstruse office, and detect its many disorders, *and put it in the fore rank of other branches with which the oculist has to deal.* For if I am not much mistaken, in the controlling apparatus of this function, is seated the octopus of human ills we call asthenopia.

We need a clearing up of the nomenclature of this function-orientation. *Orientation* covers the expression of this function, but there are divisions in it of faculties that are distinctive.

Projection is looking, regarding, it is the direction of casting an eye, and ought not to be confused with other faculties of orientation. This has to deal with the fovea, the axis, the nodal point, and the accommodation. It is a congenital faculty, and is concerned in obtaining a clear picture on the retina, of the object contemplated. The science of refraction administers to its defects.

The faculty that gives us dimension, situation, bearings, depth, relation, distance, contour, solidity, form we may call *perspective. This faculty is an acquired one; gotten by experience.* "The maintenance of correct binocular vision is the necessity which dominates the ocular muscles" (Noyes). The important function of *fusion* is here a prominent feature.

On this faculty depends efficiency in action, and safety from accident. In normal eyes there is a quickness and facility of movement exceeding the muscular movement of all the other muscles of the body, and upon this system of muscles the brain is furnished information for judgment of action. "The image falling upon the periphery of the retina gives us warning signal to cast our eyes upon the object which excites the image. It is moving objects that are most sure to attract our attention, for the peripheral portions of the retina have a higher degree of sensibility for the perception of movement" (Fuchs). There is no other faculty in us that gives more pleasure and enjoyment of life; greater buoyancy and vivacity of spirits and manner, larger confidence in the initiative. One with this function normal gets credit for sagacity, acumen, common sense, discrimination. This is because acute observation depends upon freedom of action of the eyes. There is built upon this easily acquired natural trait, confidence and courage and self-efficiency.

From an experience of twenty-five years in treating the muscular system for asthenopia, with view of getting free action of these muscles, with unexpected success, and of late concluding that in doing so, I have been administering to the disordered function of orientation, I believe I have thus allocated these several faculties that have been so abstruse in ophthalmology.

The repugnance among those who administer to eyestrain to listen to the detailing of symptoms associated with eyestrain, may be attributed to the want of appreciation, on the part of the oculist, of the *function of perspective*, which is disordered, and which the patient is attempting to describe, though, himself, unaware of its entity; also to the habit of the practitioner to attribute the causes of the phenomena of all eyestrain to errors of refraction (mechanical) and correcting the slightest defect at a venture. If his attention could be directed to an apparatus having control of as broad and important a function as orientation, he could better appreciate and properly place the symptoms described, and seek a pathological method for its solution.

We have been a long time finding the elements of the function of sight, and properly allocating them; we have applied a deal of the sciences of algebra, geometry, physics, and surgery to the mechanics of the question, but have neglected the physiological side of the problem. For fifty years we have practiced Professor Donders's system of *Accommodation and Refraction* and what we have learned of the complication of disorders of the muscular apparatus in the function of these organs, we have depended upon correcting through the focal apparatus and tenotomy of the muscles.

The art of glass fitting is the administering to the function of *projection*, and goes no further. Besides to seeing well, which glasses afford, there is more frequent application for pain or eyestrain, and as one of Donders's tenets is "that hypermetropia is at the bottom of it," the adjustment of glasses has been almost the sole means of caring for asthenopia.

There is no doubt that the apparatus of motor muscles of the eye, is the mechanism and controlling power of orientation, and has an independence of the focal function, connected with it only by nerves. "In other parts of the body the muscles are constructed for strength rather than speed, but with the eyeball everything is adapted for speed" (Maddox).

It is subject to disorders, and needs as much, if not more, repair than the focal part. I have treated the muscles by gymnastics with the idea of strengthening the muscles, but of late years believed that in the process which carried this out *I was getting rid of obstruction, probably débris of hyperemia or inflammation.* The hyperemia of the retina would clear up, the conjunctiva and the sclera would very soon get rid of its vascularity, even iritis would be dissipated. I have concluded from these experiences that the pathology of asthenopia, is the deposit of this débris, and in the exercise of the muscles I have pumped it into the circulation, leaving freedom of action and cure of asthenopia. I have so announced this in a paper written last June, which appeared in the January number ARCHIVES OF OPHTHALMOLOGY. In this article I give the process in detail.

From the fact that this irritation, from whatever nature it may be, can disturb other nearby nerves by reflex, gives us the variety of symptoms that have been traced to asthenopia as a cause. We have seen many who had difficulties of vision, but had no pain, but would refrain from using their eyes in some kinds of work. There are people that seem to have nerves of wire and very little sensibility, and yet have deflections or imbalances.

Then again, it is very true that many people pass through life without having trouble with their eyes, or at least do not complain, but among those who claim good eyes, there are many who are deficient in the faculty of perspective, and who are unable to overcome a 10° prism by the laterals; although they do not have pain many are slow in movement and cannot fix readily.

When this function is better understood, and the value of it properly appreciated, the tests for eye phenomena that have been recorded, will have to be revised, and based upon experiments made on those of proved healthy eyes. It is found that Helmholtz must have had some defect of his eyes, as some of his observations are not verified.

If there is truth in the assertion of Tscherning that we measure distance and relation of objects by the sense of the amount of innervation expended in performing the act of looking, then when these muscles have obstructions in movement and require expenditure of innervation, more at one time than another for the same movement, we have no criterion to base a measurement in orientation in eyes that have asthenopia.

We have also to deal in this function of orientation with light sense, color sense, and form sense, the faculties of accommodation, convergence, and direction and the conjugation of the two eyes to act as one organ.

Perspective, or that use of the term in the fine arts: the perception of space, form, depth, color, light, and shade, is usually thought to be an acquisition of the æsthetic and cultivated by the intellectual, a requisition of the cultured. There has been no thought of its being a leading factor in the skilled artisan and practiced every day by the laborer in the use even of the pick; or that it has an intimate relation to every one's safety in every day perambulations. Nor is it taken up by the ophthalmologist as a function important to be preserved in good order. Neither are the deficiences of perspective or orientation described by patients as such, but they complain of difficulties experienced in vision which should be assigned by the oculist to anomalies of the muscles—the apparatus which functions perspective.

Let us now convert this significant æsthetic attribute of the beautiful, into practical current everyday conduct. One who has lost the sight of one eye is not only handicapped in the social realm, but he is incapable to perform many of the requirements in manual labor and other industrial pursuits, and is continually meeting with accidents, though he learns caution and goes slow. He cannot drive nails and cannot compete in mechanics, and should not be about machinery.

A ranchman told me of a man in his employ, who when harrowing in his orchard, was continually barking his trees, and as he regarded him as a willing and intelligent workman, it puzzled him to know why he should be so careless. When I told him the fact that a man with one eye could not measure distance, he accepted the explanation and kept his one-eyed man on other work. The man changed his employer, but soon left his second place, and now is selling stoves. I often meet one-eyed collectors. A one-eyed man should always carry a cane. No man with but one eye should be a motorman or run any kind of vehicle, much less try aviation.

But a man with one eye is not troubled with asthenopia, for asthenopia comes from the defects of binocular vision. There are cases reported where the surgeon had given up in despair his ability to relieve his patient with two eyes, of the terrible distress of binocular vision, and he proposed enucleation of a good eye. It is an actual fact that there are several cases in which this has been done.

One characteristic of asthenopia is its periodicity, and another that often these cases can freely enjoy themselves, perhaps for hours, and not feel any inconvenience, and retire feeling well, but before morning will suffer severely, and are often confined to their rooms one or two days. This is pathognomonic of its reflex nature; sea sickness is another example —a reflex upon the pneumogastric. Another prominent symptom is a dread of motion. They cannot endure the "movies"; the quick fixation required, is wanting.

We all know of the almost universality of nervous symptoms in American people. In this country there are more hours given to reading than in any other nation; the masses are better educated and employments are so subdivided i to special duties that very few muscles are called into the tasks, and in nine-tenths of them the eyes are used severely; then this apportionment of work calls into action so few other muscles, that the muscular system is not evenly built up or kept vigorous, and the power of resistance is weakened, and nervous symptoms are developed.

Again: The symptoms of disordered eye muscles, often have such subtile and mysterious phenomena, that they are difficult to depict or to understand whether they are belonging to the physical, mental, or moral nature, or simply are idiosyncracies of disposition. The collection made by Dr. Geo. M. Gould of expressions of men, who undoubtedly had asthenopia, and who are used to literary expressions of the most graphic kind, I regard as a contribution to the subject I am trying to elucidate. The doctor's mistake is in attributing the phenomena to the need of proper lenses. We know something of the percentage of people who have some reason to complain of their eyes from the amount of glasses worn. There is an army of men making a living out of it. More than half of these applicants for relief, at least, have the trouble wholly in the motor muscles, and who discard their glasses within two years as useless.

I believe that one half of the community have asthenopia, and two thirds of these have disorders of the apparatus of orientation. The theory I have advanced as to the pathology of asthenopia, fits well into the phenomena, both as to the course of the ailment, and a working basis for relieving it.

The subjects of this disease are found in every occupation, and thousands are driven out of remunerative employment to take others "for want of adaptability." Some are aware of their affection and some are not. A young preacher became a book agent, because he could not study. The treatment of his eye muscles, fifteen days, one treatment a day, enabled him to go back to his chosen work. A dentist played the trombone in an orchestra at night; one evening everything turned black before him, and he tumbled off his chair. He was put to bed for biliousness. The treatment of his eye muscles cured him of asthenopia, though he had tried glasses, and he is now at his former work. An electric worker, who did inside work, was no longer able to stand on a ladder. His physician doctored him for indigestion for three months and then told him to consult me for his eyes. He was surprised and declared he had good eyes, but he came: Vision $\frac{20}{\text{XX}}$, orthophoria, but weak duction. In less than ten days he went to work, and remained cured for two years, when I lost sight of him. I have the records of scores of teachers who gave up their work, and could only do housework; also a number of students who broke down in college. One miniature painter who had learned her art in Europe, and opened a studio in New York City, broke down, closed her studio, and came home to Iowa and for two years could do no palette work. In two weeks I cured her and she opened a studio in Chicago, and took the prize for miniature painting in Philadelphia. A poor woman over fifty years of age could only do kitchen work; gave up reading for years, could not read the papers. Treatment of a very few days enabled her to read. During treatment she asked, if I cured rheumatism with that instrument. She had had cramps in her toes and folding of her fingers, but since treatment for her eye muscles, she was entirely free from the ailment. A ranchman was troubled with intolerance of light; wore black glasses out-of-doors. In forty treatments, all at once nearly at the end of the treatment, he found he could go in the light without his glasses, and throw back his hat without discomfort in the sunshine of Oregon. He remained well when last heard from six years after. In one case, treated for weak muscles and lid congestion, attained to standard in twelve treatments. One year after she reported that a goiter she had had for years, had disappeared. Car sickness of twenty years' duration, after being fitted with compound glasses by one of the best reputation in the country, was entirely cured, and would not wear her glasses afterward. For three months I had her under observation and there was no return of trouble.

I have cured three cases of chorea, and I believe one of locomotor ataxia, though an osteopath, who I found was treating her at the same time, claimed it. Two cases of enuresis were relieved.

I might truly enlarge on the prevalence of asthenopia, and its remote symptoms to such an extent that it might excite ridicule, but in my experience of practicing and teaching this subject, I have repeatedly had strange and seemingly foreign symptoms related to me in muscular treatment that were relieved, that would compel me to believe they belonged to this yet obscure and neglected function; symptoms that were responded to by physicians with a grim smile and "thrown over their shoulder" and which produced from them a moral lecture on self-control, etc.

The most persistent interpretation of symptoms by general practitioners (especially if the patients had frequently changed their glasses), was that some remote cause produced them, and a six-months' rest in sanatoriums or a course of treatment was instituted. We seem never to get rid of the idea that neurasthenia produces eyestrain, but I am convinced that the most frequent is that eye trouble produces neurasthenia.

There is one expression of this disease which I can only name desperation; it often comes in waves which overwhelm the patient, and he cannot sit still, but dashes away and walks it off. This feeling of desperation has often been described to me, and leads me to believe that in some suicides and other crimes there might be some explanation for them in asthenopia.

Knowing, or at least believing, that car- and seasickness also belong to a disorder of this particular function, showing a reflex on the pneumogastric nerve, I have often thought that "heart failure," a mysterious and senseless diagnosis, might have some connection with asthenopia.

My excuse for the details of symptoms is for the purpose of showing the connection of these widespread nervous conditions with this function orientation. This function has such great utility in the walks of life, and has such a diversity of manifestations of its ailments, that it is of first importance in ophthalmology.

I base my thought of repair on this apparatus of orientation, on disciplining the muscles that they may be free from spasm and work with perfect mobility and quickness of action.

I have long since come to the conclusion, that the muscles of the eyes are constructed and attached to the ball in accordance with the environment of human uses of that organ, and have long since quit whittling them. They have a wonderful fitness and adaptability to circumstances, and in time can adapt themselves to new requirements. Undoubtedly the condition of parallelism is best fitted from which to start on duty, and to which to return when it is performed. This is the point of rest when the eyes are open; this, of course, the point to which we should aspire to bring them, and give them as much ease of action as well as swiftness to call to duty.

I would not be understood as ignoring refraction. Many a pair of eyes have been relieved by correcting ametropia, but the fitting of all eyes that hurt with a pair of glasses, is a terrible exaggeration of the art. The attention to the apparatus which has in charge the orientation outranks it in importance.

AN ANALOGY.

The American watch is a beautiful and a marvelously perfect mechanism, and is now so common an instrument in the economy of human affairs that it has become a matter of course that it should, and really does, keep good time. But in the regular adjustment of business affairs it is a small part, for instance, in the keeping of an appointment. It does nothing towards getting the man to the agreed location; the motor appliance of transportation is independent of his watch; it fulfills an important point, but the orientation must be accomplished by another process. So I may say with some apology, that focus of the eyes in the function of vision has but the same relation as the timepiece has in the active transactions of everyday business.

The faculty of perspective has an almost independent relation; the universal (pretty nearly so) usage of prescribing glasses to this apparatus of perspective for eyestrain, and ignoring the delicate and most important part of the apparatus of orientation, is a travesty on ophthalmology.

Suppose in the morning arraignment at the Police Justice Court a "drunk" was lectured thus: "Mr. Jones I am convinced that your plight which caused you to be 'run in,' was owing to the fact you had no watch. If you had had, you would not have so blundered by your inability to orientate and get so far from home. You were no doubt, surprised to find yourself in jail this morning; your sense of location was destroyed, and you were in great danger of losing your life. I advise you to procure two watches, and that you have them repaired here, every three months."

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. CONRAD BERENS, Jr., Secretary.

MEETING OF FEBRUARY 16, 1920. DR. A. E. DAVIS, CHAIRMAN.

Dr. Daniel H. Wiesner presented a patient, a child of 9 years, with bilateral **disseminate choroiditis** and no central vision in the left eye. Both the Wassermann and the tuberculin tests were positive.

The subject of the evening was **wood-alcohol poisoning.**

(a) **Clinical aspects**, with special reference to the eyes and Committee report.

Dr. Coleman W. Cutler, after speaking of the important work done in this country by Wood and Buller, Holden, Allport, the Committee for the Prevention of Blindness, and others, described the general and ocular symptoms of wood-alcohol poisoning, emphasizing the two following points: First, unless the case is seen very early and the diagnosis made and reported at once, there is little chance of obtaining the evidence required to convict those who have sold the poison. The law has frequently failed because of delay in obtaining evidence. Second, cases of optic atrophy come to our clinics not infrequently in which the cause is undiscovered.

Chronic changes occuring when wood alcohol is used as a solvent for shellac in hat stiffening are chronic conjunctivitis, moderately congested or atrophic optic nerves with vision reduced to one-half. Acquired tolerance has been noted.

The Committee appointed by the Section of Ophthalmology reports that it has conferred with the Committee on Public Health of the Academy of Medicine; that measures were taken at once for a conference with the President of the Wood Products Company; that the attention of the Board of Health was called to the fact that wood-alcohol poisoning was not reportable and that urgent measures were needed to enforce existing laws.

As has been stated, the name methanol has been substituted for wood alcohol and the strength of the denaturant reduced from ten per cent. to two per cent., thereby rendering denatured alcohol innocuous. The meeting to-night is a final result of the work of this Committee.

(b) The **pathology and pathological chemistry of wood-alcohol poisoning** by Dr. CHARLES NORRIS.

Attention was called to the prominent part which ophthalmologists, especially those of our country, have played in arousing the community to the dangers of this form of alcohol. He entered into a discussion of the difficulty in the determination of the cause of death in many of the cases which come under the jurisdiction of the Chief Medical Examiner's office.

Attention was called to the slight, indefinite and unsatisfactory results obtained in the microscopic examination of the sections of the nerves, especially of the optic nerves, in the cases which have come under his observation, the reason being that the cases were rapidly fatal cases of poisoning, in which one does not expect to find the lesions described by Birch-Hirschfeld, Holden, and others after experimental poisoning in animals.

The necessity of chemical examination of the viscera in suspected cases of poisoning was emphasized.

A statistical table was given of the number of cases of methyl alcohol poisoning which occurred during the years 1919 and 1918 in New York City.

(c) Some **chemical aspects of the wood-alcohol problem.** Professor CHARLES BASKERVILLE described the manufacture of wood alcohol and its legitimate uses. He favors the elimination of the name alcohol as of great importance removing as it does the symbol or idea of the intoxicant which the qualifying "wood" or even the poison label has not always accomplished.

(d) **Legal aspects,** Professor JOSEPH P. CHAMBERLAIN. The problem of restricting the illegitimate uses of wood alcohol, is one of regulation and belongs to the nation rather than the

State. National regulation can best be effected by taxation. This result could be achieved by taxing wood alcohol and by allowing withdrawal of the alcohol tax free for shipment to manufacturers, the tax to apply the instant the product was sold to any but a registered manufacturer.

DISCUSSION: Dr. WARD A. HOLDEN: The warning that the public has received, together with the present status of the wood-alcohol industry, seem to guarantee us against any great amount of wood-alcohol poisoning in the immediate future.

The favorable features as regards the industry are three in number:

1. The refiners of wood alcohol have changed its name and now designate all grades as METHANOL.

2. The restriction in forestry operations has cut down the supply of wood alcohol, while the demands for wood-alcohol products in agriculture, moving-picture films, dye industries and the like, have been greatly increased, both here and abroad, thus raising the price to $1.80 a gallon.

The legitimate industries in the future will take the entire output, leaving none to be scattered in small lots, as in the past, in pharmacies and paint shops.

Denatured grain alcohol which costs but 60 cents a gallon, one third the present price of wood alcohol, will soon entirely take the place of wood alcohol for use by the general public.

3. Because of the scarcity of wood alcohol the Federal Government now requires in the production of denatured grain alcohol the addition of but 2% of wood alcohol as compared with the 10% required before January 1, 1920. And it is likely that, following the lead of European countries, the Government will soon permit the use of a lower grade of refined wood alcohol which is less toxic and also more nauseating than the grade now required. Hence the danger from denatured alcohol is greatly lessened.

In regard to legislation, we have gone slowly, knowing that any bill that hurts the refiner will be blocked by him, and any bill that hurts the other industries will be blocked by them. Further Federal legislation may prove to be necessary, but it should be very carefully considered from every point of view, and no Federal supervision should be urged that will appreciably discourage industries and increase the cost of living, which Federal supervision invariably does, unless we can be quite sure that it is not needless, and that it will diminish materially the prevalence of wood-alcohol poisoning in the future.

Dr. H. W. WOOTTON stated that he had recently been able to examine the fundi in two cases of methyl alcohol poisoning shortly after the onset of symptoms. In both, the retinal veins were somewhat dilated, but there was no marked papillation. The disks were pale and their outlines hazy, but there was no distinct elevation. Perception of light was absent and the pupils widely dilated. Both recovered sufficient vision to enable them to go about, and later the disks became very pale. He did not think that a further improvement was possible. In fact, one of the cases after three months showed a renewal of decrease in vision. The fields were contracted.

Dr. CRIGLER said that a case recently seen by him in association with Dr. Wootton emphasized the importance of a change in the name of this deadly poison. A Russian Jew age 30 had deliberately consumed the contents of three three-ounce bottles of wood alcohol—taking only a small quantity at a time—despite the fact that each bottle bore a poison label as required by law, and despite the fact that he intelligently read the labels; he said he thought that he could take a chance by taking only a small quantity at a time; recovering from the effects of the first few drinks with only slight drowsiness and abdominal pain—which he attributed to something that he had eaten and not to the poison—he took several larger drinks in succession. His abdominal pains became so pronounced that he was compelled to seek relief. Returning from the doctor's office he became unconscious, was taken to Bellevue Hospital and remained in a comatose state for three days. When consciousness returned he was totally blind. There was a gradual restoration of his sight so that at the end of six weeks his vision in the right eye was $\frac{20}{70}$ and in the left, $\frac{20}{100}$. His vision to-day, three months from the date of the poisoning, is $\frac{20}{100}$ in the right eye and $\frac{8}{200}$ in the left; the fields are markedly contracted; color perception is almost completely abolished and the nerve heads are white with an atrophic excavation. The arteries especially are considerably contracted in size.

MEETING OF MARCH 15, 1920. DR. A. E. DAVIS, CHAIRMAN

Dr. S. A. Agatston presented a patient with **sarcoma of the left orbit,** extending from the antrum.

F. L., male, age 64 years, hospital orderly. Three months ago began complaining of pain in left side of his face. He was treated for facial neuralgia. Two months ago his left antrum was irrigated, but no pus was found. The pain continued more severe up to the present time. Three weeks ago, the patient noticed the protrusion of his left eye and swelling of his face. Since that time the swelling steadily increased. At times there was diplopia. The patient lost twelve pounds in weight during the past three months. His family and previous history are negative.

Present condition: Swelling over the left maxilla; pulsation of his left cheek and left eye, but no bruit; hyperæsthesia of the area supplied by the infraorbital nerve; tenderness on deep pressure over the malar bone; increased respiratory sounds over the left antrum; exophthalmos of about 8*mm*; limitations of ocular movements are only slight; diplopia in the lower field; chemosis of the lower half of the conjunctiva; pulsation of the left fundus synchronous with the pulse; left papillœdema. Vision: O. D. $\frac{20}{20}$, O. S. $\frac{20}{70}$. The fields for colors are contracted. X-ray shows diminished illumination of the left antrum, with diffusion of the outer border suggesting a new growth. Wassermann negative. No evidence of growth elsewhere in the body.

A tentative diagnosis of sarcoma of the antrum, extending into the orbit was made.

Dr. Agatston also presented a patient with **dislocation of the lens into the vitreous chamber.**

Patient G. J., was struck in the eye by an unknown object thrown at him. He was brought to Bellevue Hospital (Dr. May's service) with swelling and laceration of the lids as well as subconjunctival hemorrhage. The cornea and anterior chamber were clear. There was no retinal reflex and it was impossible to see the fundus, owing to hemorrhage in the vitreous.

After a few days, examination showed the presence of a tremulous iris, the lens dislocated toward the nasal side and tilted backward, the convex edge seen across the pupillary area;

the vitreous filled with large opacities. The next day, the lens disappeared from the pupillary area, but was found at the bottom of the vitreous chamber. X-ray showed no fracture, or foreign body in the orbit. Vision: hand movements. Fields normal, but no color perception. Tension 18 (Schiotz).

Dr. DANIEL H. WIESNER exhibited a patient with **deep keratitis**, in whom the Wassermann and tuberculin tests were positive. The child has been under observation eighteen months and has had treatment for lues and tuberculosis. Two weeks ago the patient developed bilateral inflammation of the irides with spots on Descemet's membrane. The twin sister gave a negative reaction to the Wassermann test and a tuberculin test was only slightly positive.

DISCUSSION: Dr. H. H. TYSON stated that it was not uncommon to find tuberculosis and lues in patients with interstitial keratitis and that while both may exist, one or the other might be the predominating cause, while in other cases, both may appear to share equally as the causative factor. Judging from the appearance of the cornea in the case under consideration, he was of the opinion that tuberculosis was the predominating cause and suggested continuing the tuberculin treatment and the use of tonics; later anti-luetic treatment if necessary. He advised against the use of potassium iodide in patients suffering from tuberculosis as he was of the opinion that it was more injurious than beneficial.

Dr. A. E. Davis suggested that the mental inferiority of the twin child affected with the keratitis as compared to the well child was only apparent and that the backwardness of the sick child was due solely to the fact that she could not use her eyes at school.

Dr. ALEXANDER DUANE demonstrated what he called the **complementary color test** but what might better be called the extinction test.

This is usually applied with the tangent curtain, and, for examining central scotomata or the blind spot, at a distance of sixty inches; for examining hemianopsia at a distance of thirty inches. Suppose we are examining the left eye. The right eye, covered with either a deep amber or a ruby glass fixes the central spot of the curtain. The left eye is uncovered. A dark blue disk on a carrier is pushed in various directions along the curtain. This spot is invisible by the right eye, because extinguished by the colored glass. It is visible to the left eye as a rather lighter blue, until it enters the scotoma when it disappears sharply if the scotoma is absolute or becomes dim and dark if the later is relative. The red glass is particularly serviceable in testing the blind spot, because with this any straying from binocular fixation is rendered evident by the fact that the little white central spot used as the point of fixation appears as two spots, one red and the other white. If the patient's attention is called to this fact and he is made to fuse the two images, sharp central fixation with the left eye is maintained and we get no uncertainty about the limits of the scotoma.

Dr. DUANE read a paper on **some theoretical and practical points in refraction work** (appears in this issue.)

Dr. G. W. VANDEGRIFT read the second paper on **the optics of the cornea** (appears in this issue).

DISCUSSION: Dr. ELLICE M. ALGER said that most ophthalmologists assumed that refraction was a finished subject, to which nothing of importance had been added since the time of Donders and Helmholtz. We were rather proud of the statement that it was nearer to an exact science than any other department of medicine.

Theoretically, modern methods made it possible not only to save time but to rely almost entirely on objective examination. Some men even had as their ideal a system under which it was not necessary for the patient to open his mouth. If refraction were an exact science, it naturally *should* follow that any well-trained man could do it, and that all should get practically the same results. If the patient was not comfortable with the resulting prescription he is assured that his examination was made carefully and scientifically and that it was his misfortune if he could not wear his glasses. Moreover, doing this simple, scientific, objective, impersonal thing over and over bored us to death. It was as exciting as examining a series of schematic eyes, and most men looked eagerly to the time when they could shift this drudgery to an assistant.

Practically, however, we all knew that refraction was more than a science; it was an art based on a science, in which the more scientific man was not always by any means the more successful artist. Moreover, practiced as an art, which allows for judgment and experience and even intuition, it became interesting.

Dr. Alger thought we were paying too much attention to static measurements and not enough to dynamic ones. Our very terms were misleading, for the emmetropic ideal eye was often far from the perfect eye in actual use while the ametropic eye often functioned perfectly.

Accommodation was a very complicated function, which was not to be done voluntarily but only under the imperious desire for distinct vision. Some people could not even think without fatigue and were entirely unequal to even the nervous stimulation of accommodation. Others probably lacked the knack of coördinating perfectly normal muscles, like the athlete who was so muscle-bound that he could not throw a ball.

The elasticity of the lens we recognized as an essential element in focusing, greater in childhood and declining with age, but whether this decline was purely a matter of age or depended partly on factors more or less under our control, like diet or toxemia, we knew very little. It was even possible that the lens, like an India-rubber band preserved its elasticity much longer when actively used. An inelastic lens caused poor vision but did not in itself result in discomfort, which proceeded from the muscular element in accommodation.

The natural instinct for clear vision led us automatically to stimulate the ciliary muscle, not a measured amount, but till we got results. When the most energetic squeezing failed to clarify vision, many people never seemed to learn the futility of the effort but kept straining clear into old age and complaining bitterly of the pain and fatigue.

When we measured accommodation we really measured the change in the lens and had no idea of the amount of energy used in producing the result. As far as actual power goes we had no reason to believe that the ciliary muscle of a healthy adult was essentially weaker than that of an infant. In the one a slight contraction produced a tremendous result while in the other a much more powerful one produced hardly any result at all.

The art of refraction is very largely a study of the muscular compensation for ocular defects, and cannot be done by rule of thumb. If we removed part of the load we removed for the time being all the patient's disability; he could take care of the rest. It was even possible that we did him more harm than good by removing too much of his burden, by strong glasses, just as the cardiac patient often did much better under graduated exercise than under complete rest.

When compensation had actually broken down it often required the nicest judgment to decide the best proportions of rest and exercise and glasses.

Dr. Alger was sorry to see the growing dependence on cycloplegics; not that they were not often necessary, for they were, but that in many cases the patient's actual needs could be better met without them. They often obscured vital elements in the problem and sometimes seemed to paralyze the initiative of the physician even more than they did the accommodation of the patient. They should be omitted or used according to needs of the individual case.

Dr. Alger thought there were far too many people in the world wearing weak glasses all the time, who would be much happier with no glasses at all, or stronger ones for near work only. Many of us had suffered this in our own persons. We were willing to admit that glasses were a great blessing, but they were also a nuisance. If we put them on a patient it should be only after a study of his individual needs has convinced us that they were really indicated, and not because he had a good nose to hang them on.

Dr. J. Herbert Claiborne said there were two things that nature seemed to abhor—a blurred image on the retina, and more particularly a distorted one; that the accommodative apparatus was intended primarily for the purpose of focusing divergent rays of light within twenty feet, and that the impulse was so profound, the mind naturally turned to the accommodation as the only means of eliminating a blurred focus on the retina. In the case of spherical hyperopia, this is done by the muscle of accommodation but in hyperopic astigmatism the apparatus was incapable of overcoming the blurred image by reason of the difference of refraction in the two principal meridians, nevertheless, the brain would attempt to overcome the blurred image whenever it occurs. This is the cause of accommodative strain which produces so many symptoms. A distinct image is desired at any cost and the cost of the futile effort or the successful effort is paid for in the coin of pain or other discomfort.

It is safe to say that seventy-five per cent of our work is refraction, hence the importance of this subject. He used cycloplegics in all children and generally in people up to approximately thirty-five years of age, but he insisted on three examinations before, during, and after the cycloplegic. This was necessary to render a correct judgment. Both science and art were involved in the correction of the refraction of the eye. A knowledge of optics was absolutely necessary and was the basis of all further investigation but the art consisted in applying these principles and many others which are ordinarily not considered a part of science but in reality are. They are character, patience, persistence, knowledge of psychology, charity of heart and soul, loving-kindness and the realization that the patient knows what he wishes, knows when he has it and hasn't it, and has quite as much sense, if not more, than the examining surgeon. He recommended to young men in preparing themselves for the correction of refractive errors, to make a study of anatomy, physiology, mathematics and physiological optics, and then, after much prayer and fasting, to prescribe with fear and trembling. The main object is to satisfy the patient, and make him see well with comfort and ease.

Dr. A. EDWARD DAVIS spoke of his experience with the use of the Souter ophthalmo-phakometer. We are indebted to Dr. Souter for adding one more valuable objective test in estimating and correcting refractive errors. As you are aware, with this instrument we not only measure the corneal astigmatism, but the lenticular astigmatism. Dr. Souter has stated that after measuring many hundreds of cases of refractive errors with his instrument he found that the sum of the corneal and lenticular astigmatism (the posterior lenticular surface is the one chiefly affected in astigmatic errors) conformed with the subjective astigmatism to within .25 D. in the vast majority of cases. His experience in the use of the instrument agrees entirely with that of Dr. Souter. Even before the advent of this instrument, he rarely made use of cyclopegics in refractive work in patients over fourteen or fifteen years of age and since employing it, he finds even less necessity for using cycloplegics as a routine measure in fitting lenses.

Dr. DUANE in closing said that the apparent discrepancy between his statements and Dr. Vandegrift's with regard to the effect of the posterior surface of the cornea on the refraction of the eye was due to the fact that Dr. Vandegrift was considering only the effect exerted on the refraction of the cornea itself while his own paper had regard to the effect produced on the refraction of the whole eye.

Answering Dr. Alger, he said that Hess had assumed that the actual ciliary power was the same in people of nearly all ages, but that, as the lens hardened, more and more of this power became latent because less and less was needed in accommodation. A necessary corollary of this view is that paresis of accommodation must escape notice in people of middle age. But experiments made with homatropine prove that this is not the case, paresis of accommodation being manifest about as soon in many people over forty as in young people.

With regard to cycloplegics his experience, reported already in a paper before the section, was that considerable errors of refraction—sometimes as much as 2 D. of hyperopia and a notable amount of astigmatism—were often latent after the age of forty, and that in spite of most careful precycloplegic testing could not be elicited without a cycloplegic. Whatever glass we gave—and this must be decided by a variety of onsiderations (certainly not by the cycloplegic examination alone) —he did not see why we should not have the often indispensable information that the cycloplegic gave us.

Dr. G. W. VANDEGRIFT in concluding stated that he always used a cycloplegic in patients under thirty-five years of age and frequently in older people. He does not use a cycloplegic in older people when he is certain that his measurements are correct, both subjectively and objectively by such means as the ophthalmoscope and ophthalmometer. He would rather displease the patient by the use of a cycloplegic and be certain of the exactness of his work than run the risk of prescribing inaccurately.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

The ordinary meeting of the Section was held on March 3, 1920, under the presidency of Mr. W. T. Holmes Spicer.

Mr. J. H. Parsons showed a case in which he performed iridotomy. The patient came with **immature cataract**, in which the opacity was chiefly in the posterior cortex. He did the ordinary extraction, with a peripheral button-hole, a simple extraction first, then made a tiny hole in the periphery of the iris afterwards. The patient did well, going out with the eye quiet in ten days. A week later, however, she returned with a hypopyon and a flaring iritis, which he regarded as due to endogenous inflammation. He took her in, and treated her in the usual way, but, in spite of atropine and hot bathing, the pupil became very small, and eventually blocked. He described by means of a drawing the method in which he did the iridotomy, namely, puncturing the iris and passing a Tyrrel's hook in behind the iris, with the idea of coming out of the tiny coloboma at the top. There was a breach of iris, and she was left with an artificial pupil below, which looked like an ordinary pupil. She was left with slight vitreous opacities, but, with correction, her vision was $\frac{6}{18}$.

Several members discussed the case.

Mr. Parsons also showed a case of extraction of a **dislocated lens.**

Mr. Leslie Paton exhibited a patient who came to the hospital with certain visual defects but whom he was showing because of an extremely readily excited **vestibular nystagmus:**

it was brought on by the mere pressing of cotton wool into the ear.

He also showed a case of **blue dotted cataract.** He had previously had a similar case. The vision in these cases was usually very little interfered with, and the ophthalmoscope revealed, in this patient, very little opacity. With correction, the vision was $\frac{6}{12}$ in one eye, $\frac{6}{9}$ in the other. All, including Lord Rayleigh, seemed to agree that the blue color was not due to the presence of pigment, but to a refractive peculiarity.

Mr. Charles Wray said there was a family history of the condition in several of the cases.

Mr. Bishop Harman referred to two cases in which there was an association of this peculiarity with night-blindness. Mr. Treacher Collins and Mr. Ernest Clarke also referred to similar cases.

Other cases included one by Mr. Leslie Paton (mass of connective tissue covering the disk) and Mr. M. S. Mayou (gummata of eyelid).

Mr. W. H. McMullen showed a case of **congenital aniridia,** which was associated with some signs of glaucoma. From the momentary view of the disks which was possible, they seemed to be definitely cupped, and palpation seemed to indicate a raised intraocular tension. He raised the question whether trephining should be done, or some other form of operation with the object of allaying irritation. Or should one wait and note what happened?

Mr. Bishop Harman suggested it might be well to try cyclodialysis for the separation of the ciliary body: the results of this in Vienna had been declared to be satisfactory, and it was said to produce the least interference in an eye in regard to which one was doubtful whether any interference should be undertaken.

Mr. Frank Juler suggested that a trephine operation might be dangerous in this case, as there must be very little iris tissue left, and in making a trephine hole into the anterior chamber one was apt to wound the lens. He spoke with knowledge of a case in which he saw disastrous results.

Mr. M. S. Mayou said he had trephined a case of aniridia, and it was satisfactory.

Mr. McMullen also showed a case of **cyst in the outer part**

of the orbital margin of the left eye. He believed it to be a cyst of the orbital portion of the lacrimal gland: it was adherent to the roof of the orbit, and only loosely attached to the tarsus. It did not present behind the lid, as did the ordinary lacrimal cyst.

Mr. TREACHER COLLINS said a feature which helped to confirm the diagnosis of cyst of the lacrimal gland was that when the patient went out into a cold wind the cyst became bigger.

Sir WILLIAM LISTER spoke of a case in his experience in which a cyst of the lacrimal gland went behind the globe. The boy had proptosis of the left eye, which got worse, and the eye was pushed downwards and inwards. He did Kronlein's operation, and after cutting through the periosteum and separating the orbital fat, he encountered a very black tumor, and in proceeding to separate this, it suddenly burst in his face, and the contents practically disappeared. He feared infection at the time, as the lad had somewhat severe acne of the face. But the wound healed up by first intention, and the vision—which had gone down to $\frac{6}{24}$, with contraction of the field—was $\frac{6}{6}$.

Mr. CHARLES WRAY suggested that the cyst should first be punctured, as that would greatly facilitate its dissection.

Mr. JEREMY said he had removed a cyst from the inner side of the upper lid, and it was found to be lined with squamous epithelium and contained mucus. He thought it was a transplantation cyst, and suggested that was the nature of Mr. McMullen's.

Mr. LESLIE PATON discouraged preliminary puncture of the cyst as it might be a cyst of Krause's gland.

A New Test of Color Vision.

Dr. EDRIDGE-GREEN exhibited, by means of the epidiascope, a new series of cards designed to test various forms of color vision defect. The basic idea was a large number of fancy forms which could not be described or memorized by the person submitting to the test, and these were, in succeeding cards, colored in various ways, and large designs wrought in one color with a varying background. He had not known this test to fail in any single case.

Mr. J. H. Parsons pointed out the great difficulty of ensuring that every test-set bore identical shades of color: that had been found to be a real drawback in all the published tests. Not only did different editions of the prints vary, but copies of the same edition did so, no doubt largely to the fact that aniline dyes faded, and the progressive penetration of the color into the lithographic stone.

Cobalt Glass in Detecting Astigmatism.

Mr. Leslie Paton read a note on the use of cobalt glass for testing for errors of refraction, especially small errors in astigmatism, his object being to refresh memories of the use of this glass for the purpose. He gave a demonstration.

In the discussion it was stated that there was likely to be unnecessary trouble in testing if this were employed, as patients would worry unnecessarily over quite trivial errors and bother the ophthalmologist accordingly.

The Treatment of Prolapsed Iris following Perforating Wounds.

Mr. Charles Goulden read a paper entitled **The treatment of prolapse of the iris following accidental perforating wounds: with a note on the removal of non-magnetic foreign bodies from the anterior chamber.** He said attempts at reposition of the prolapsed iris should be avoided, owing to the risk of infection of the interior chamber of the eye, and because such reposed iris would again prolapse. The patient should not be left with the iris incarcerated, otherwise there would either be delayed healing of the wound, or a weak scar which might bulge under intraocular pressure, or defective vision due to displacement of the pupil, and irregular refraction of the cornea, iridocyclitis, or sympathetic iridocyclitis. If several days had elapsed since the wound was received, the case became much more difficult to deal with. Still, cases could be operated upon and the wound freed from uvea as late as ten days after the accident.

The author proceeded to detail the measures he employed in each type of case, which a condensed report without diagrams could not do justice to.

The paper was very appreciatively discussed by several members.

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ARCHIVES OF OPHTHALMOLOGY.

THE EFFECTS OF THE VARIOUS TOXÆMIAS UPON THE EYE.[1]

By Dr. W. H. WILMER, Washington, D. C.

IN 1626, there appeared a small book entitled *Two Brief Treatiſes Concerning the Preſeruation of the Eyesight,* by Doctor Baily, "sometime of Oxford" (the first writer in English upon Ophthalmology). He wrote: "The preſeruation of the ſight doth conſiſt, partly in good order of diet, partly in uſe of Medicines. . . . Whoſoeuer doth deſire to preſerue his ſight, let him take heed of the inequality of the ayre, of fire, ſmoake, winde, immoderate Coiture, much labour, ſuperfluous weeping, drunkenneſſe, ouermuch ſleepe, eſpecially in the day-time vpon meat, immoderate watchings: Let them alſo auoid meates that doe ingender vapours, ſuch as Cabbidge, Coleworts, Onions, Garlike, all ſharpe things, and Salt, Sallets, Beanes, and Peaſon, all fat things, whether they be of fleſh, or of oyle; all things of hard digeſtion muſt be auoided, & all things that are vapourous. . . . The eyes of a Crow hung about the necke, ſtrengtheneth a weake ſight, and doth preſerue the eyes: the roote of ſwines-graſſe or knot-graſſe, dryed in the decreaſe of the Moone, and hung about the necke, doth alſo conſerue and ſtrengthen the ſight, neither doth it ſuffer them to be inflamed."

The attempts of these early treatises to associate affections of the eye with general bodily conditions are very interesting;

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[1] Read by invitation before the Section on Ophthalmology, New York Academy of Medicine, April 15, 1920.

but the prophylactic and curative suggestions, though most seriously expressed, seem laughable enough to us to-day. It will be fortunate for us if the efforts of the present generation do not appear equally ludicrous to our successors four hundred years hence. However, if Francis Bacon were writing now of medicine as a science, he could not say as he did three hundred years ago: "I find much iteration, but small addition."

The group of toxæmias forms one of the most important additions to the store of medical knowledge, and the literature upon this subject has been increasing most rapidly of late. The growing appreciation of the rôle of focal infections in diseased conditions of various widely separated organs is fortunately bringing the internists and the specialists into a closer relationship.

It is a far cry from Doctor Baily's "gemme of such worth" to the use of the X-ray, spinal puncture, complement fixation, and other modern methods of laboratory diagnosis. Sometimes both laboratory tests and clinical experience are sorely taxed in locating, with a reasonable certainty, the causes of obscure lesions of the eye. Yet it was not more than twenty-five years ago that practically all inflammatory conditions of the various tunics of the eye were classified ætiologically as syphilitic, rheumatic, gouty, or idiopathic.

At the meeting of the Section of Medicine, Southern Medical Association, in Memphis, Tennessee, November, 1917, an exhaustive and most instructive symposium upon oral sepsis was presented by some of the foremost clinicians of the country. The relation of oral sepsis to the digestive apparatus, the anæmias, thyroid deficiency, arthritis, the cardio-vascular system, and to the nervous system, was most ably set forth. But its relation to the eye was not included in this symposium, although from the standpoint of economics and of human happiness, the eye should be considered one of the most important organs in such discussions. In addition, the ocular tissues present great advantages for observing pathological changes during inflammatory processes. In the introduction to his *Diseases of the Eye*, published in 1840, Tyrrell says very concisely: "The investigation of the structure, of the functions and diseases of the organ of vision offers, therefore, to the student advantages and interest which are not afforded by any other department of medicine or surgery; inasmuch as he can clearly see the origin, progress, and termination of diseased action in the more important textures; can learn how disease is modified in them by internal and external circumstances; and can observe the operation of the remedial agents employed."

To consider the eye in relation to all the various toxæmias, would be equivalent to a clinical treatise upon the diseases of that organ. In the scope of this brief paper, it will be possible to speak of only a few of the focal infections, or toxæmias, affecting the eye—those of the teeth, tuberculosis, and typhoid inoculations—passing by the fascinating lure of the tonsils, paranasal sinuses, gall bladder, appendix, genito-urinary tract, gastro-intestinal tract, salivary glands, and kidneys, as well as gout, syphilis, malaria, and the endocrine organs.

Dryden wrote:

> "The circling streams once thought but pools of blood
> (Whether life's fluid or the body's food)
> From dark oblivion Harvey's name shall save."

The blood stream, as we now know it, is not only a carrier of the elements necessary for life to all tissues, but it is also a sewer, and a purveyor of all secretions from the various endocrine organs. According to our present conception of focal infections, the bacteria from a distant focus, circulating in the blood or in the lymph canals, find a location that suits their taste, and there they start building a new home. Whether the new habitat is in the gall bladder, the kidneys, articulations, the endocardium, etc., or in the eye, depends upon differing circumstances—the bacillary strain, a slight injury, a sensitizing effect of some secondary focus, cold, oxygen tension, or other factors with which we are not familiar. It is also conceivable that the toxins—by-products of bacterial life—may also set up inflammatory conditions in widely separated organs.

The resistance of the normal tissue cells to these invading hosts makes the skirmish recognizable as a sign of abnormal conditions. The reactions may vary in degree from an endarteritis obliterans, or from a thrombosis of a small peripheral retinal vein, to a large plaque of chorioretinitis—the latter in its atrophic stage presenting a veritable "devastated area."

In his *Ocular Diseases Resulting from Dental Lesions*, Dr. Arthur D. Black says in regard to eye inflammations: "The latter are practically always due to an infection involving the peridental membrane, either in the form of an alveolar abscess at the root apex, or a pus pocket alongside the root. As probably not less than fifty per cent. of all persons having teeth present one of these conditions, the mouth is doubtless the most frequent offender in cases of secondary eye lesions."

As the age of the patient advances, the amount of crown and bridge work, and the number of devitalized teeth, usually increase; so that the mouth, as a source of sepsis, has to be examined with the greater suspicion. The deeper root infections can only be revealed by the X-ray. But even the X-ray under some circumstances fails to show a damaging source of infection.

Rosenow, in his excellent article, "The Pathogenesis of Focal Infections," says: "A blind abscess at the root of a tooth, infected pulpless teeth without rarefaction of bone at the apex, pyorrheal pockets about teeth, and infected tonsils, constitute a menace to the continued health of the individual. These walled-off areas of infection with little or no chance for bacteria and their products to escape except into the lymph channels and blood stream are veritable experiments which sooner or later yield results. These foci not only afford excellent entrance ways for the bacteria and their products, but they afford also the favorable conditions for bacteria to acquire peculiar infecting powers. It is this latter fact more than any other one factor which determines the localization in a given case. The conception, therefore, of the relationship of local foci to systematic disease must not be too mechanical."

Oral sepsis can be held directly responsible not only for external inflammations of the eye, but also for all types of uveal inflammation—iritis, disseminated chorioretinitis resembling retinitis pigmentosa, and especially large serous exudations in the choroid simulating, or actually causing, detached retina.

On October 16, 1919, the writer was consulted by Miss B., whose case had been diagnosed as detached retina. In fact there was a very large choroidal exudation lifting the retina in the lower temporal quadrant. In searching for the cause of this condition, all tests were negative except the teeth. The eminent dental surgeon, Dr. Joseph Head, wrote in regard to this case: "The two teeth extracted for Miss B. were troubled with pyorrhea pockets on the sides and also had apical abscesses which unquestionably had come through the death of the pulps. Apical abscesses are particularly dangerous because pressure on the tooth causes an injection into the system of toxins and bacteria under a pressure of from twenty to sixty pounds, which is the force usually required for chewing food." After this source of infection was removed, there was a complete recovery of sight, and a full restoration of the normal visual field.

In the light of our new views in regard to tuberculosis (together with a better understood technique in making the tests), it is not surprising that a relatively large proportion of eye lesions are now found to be of a tubercular nature. In regard to these new views, Dr. Stewart says: "Woodruff (Lt.-Col. Charles E. Woodruff, M.C., U. S. A.) called attention to the present belief that every child is born free from tuberculosis, but soon acquires it, and that in every one the lesion becomes active sooner or later. He says that it is probable that all civilized people are tuberculous and undergoing constant auto-vaccination, causing an effective immunity. No one was ever infected in adult life. If incipient tuberculosis develops in an individual, it is, according to this authority, because something has interfered with his manufacture of antibodies."

Dr. Edward Jackson, in *Tuberculosis as a Focal Disease*, says: "But the facts that stand prominently forth in all the accumulated literature are: The tubercle bacillus gets entrance to the body usually long before any of the effects of its presence are recognizable, and often makes itself known first in the interior of the eye, in the head of the femur, or the bodies of the vertebræ. It has been known to enter the body without giving the slightest evidence at the point of entrance."

Dr. Jackson's description of the tubercle as a focal infection is classical. He says: "It exhibits all grades of pathologic achievement, from massing of leucocytes and the proliferation of fixed tissue cells required to resist invasion, through degenerated epitheloid and giant cells to fatty, cheesy, and calcareous masses of cell debris."

To the better understanding of making the tuberculin test, another source of helpfulness has been added—the fuller education of the laity in regard to the true nature of tuberculosis and their better coöperation in making satisfactory tests. Not long since, a young, strong, athletic patient who was undergoing the tuberculin tests, said: "I hope that they will be negative. I have the greatest horror of tuberculosis in any part of the body—it seems so dirty and horrible. I would a thousand times rather have syphilis." His case proved to be a typical one of tuberculosis of the retina. But he has accepted the positive findings, and he is now very happy over the improved eye condition.

There is another great element in dealing with the increasing number of eye lesions found to be tubercular—we are learning, in the case of adults, to have faith only in the subcutaneous test, and to use the boldness born of enlarged experience in giving the injections sufficiently strong to overcome the previous individual auto-vaccination.

Tuberculosis is as impartial as oral sepsis; and there is no tissue of the eye that is not influenced by the tubercular process. But in the writer's experience, it shows an especial predilection for the cornea, the retina, and the uveal tract. But the retina affords the best opportunity for studying with the ophthalmoscope the various pathological changes. Here, one can also detect slight focal reactions to the tests. In a recent article upon "Tuberculosis of the Retina," by Dr. Jackson and Dr. Finnoff, the authors state that: "Retinal tuberculosis begins by the appearance of white infiltrates in front of certain retinal vessels, most frequently veins. Later these particular vessels show all the signs of perivasculitis and the affected portions of the veins may be altered in caliber. At this stage hemorrhages occur and the patient is likely to first come under observation for impairment of vision."

There is a type of retinal inflammation, usually of tubercular origin, that is of deep interest and of great economic as well as humane value—recurrent hemorrhages of the retina in young adults, chiefly males. Before the true nature of this process was understood, the history of these otherwise healthy and vigorous young persons usually showed years of unproductiveness and apprehension, with finally the loss of one eye or both.

In addition to other cases, Dr. A. E. Davis and Dr. Finnoff have each reported a case of this general type.

The following case is reported in some detail on account of the unusual good health of the patient, the long continuance of the trouble, the negative reactions to several Von Pirquet tests, the positive reaction to the subcutaneous injection, and the final improvement as the result of the therapeutic administration of tuberculin.

J. B. W., 25 years of age, first consulted the writer on February 3, 1920. He gave the following history: Recurrent attacks of iritis in the left eye during 1913 and 1914. In March, 1915, noticed large floating specks in front of the left eye. They gradually became larger until a month later when that eye became practically blind. Consulted an oculist who found the vitreous of the left eye filled with blood. A few months after loss of sight of this eye, black specks appeared in the right eye, later taking the form of long floating lines. In August, 1917, a large hemorrhage occurred in the retina of the right eye. This became absorbed after two months' stay in a hospital. During the past few years, the patient has kept rather quiet, but small hemorrhages have continued to occur up to the present time, causing both visual disturbance and great apprehension. The patient said: "I have been thoroughly examined and the doctors cannot find any cause for the trouble. I am not a bleeder."

Family History.—Negative. One brother and one sister living and very strong. Father very healthy, mother died of pneumonia.

Personal History.—Very robust and athletic. Tonsils removed two years ago. Sinuses reported clear. Two suspicious teeth have been extracted. Present condition: Complains of not seeing with left eye. Lines and spots before right eye. Lower portion of all lights appear red. R. E. V. = $\frac{20}{20}$ J1 at 6″ without glass. L. E. V. = $\frac{1}{200}$. R. E. field, blind spot, light sense, color sense, and pupillary reaction, all normal. Fundus R. E.: Thrombosis of a branch of superior nasal vein, inferior temporal vein, and of a vein in the extreme nasal periphery, on the level with the disk; white infiltrates around thrombi; perivasculitis, many minute hemorrhages scattered through the fundus, especially near the site of the upper thrombus. Numerous dark brownish discolorations in the lower portion of the retina over the ora serrata—evidently the remains of previous extensive hemorrhages. Vitreous clear. L. E. : Scar in retina and choroid above the macular region, with a dense band of organized fibrous tissue in the vitreous stretching horizontally over the macular region and papilla, constituting a retinitis proliferans.

Report by Dr. W. C. Moore of physical examination and laboratory findings: "A well developed and well nourished young man, weighing 176 pounds, height 5 ft. 10½ in. with acne scattered over back, chest, and shoulders, mucous membrane pink. The left tonsil has been removed and there is a small portion of the right tonsil left.

Oral hygiene good; teeth show a number of fillings but are in good condition. There are no capped teeth. Thyroid is not palpable.

Lungs.—Expand equally on the two sides and the lower borders move freely on deep inspiration. The percussion note is resonant, and the breath and voice sounds are normal.

Heart.—Area of cardiac dullness is normal; apex 5th int. space inside left mam. line. The sounds, both at apex and base, are clear and distinct; P2 greater than A2, neither accentuated. Pulse 66, regular in f. and f., and of good volume. Vessel walls are soft.

Blood Pressure.—120 sys.—70 dias.

Abdomen, genitals, and extremities negative.

Reflexes.—Both superficial and deep are present and normal, and equal on the two sides.

Laboratory Examination.—Urinalysis (voided spec.): Very light, clear, faintly acid; 1010; albumen negative; sugar negative, acetone and diacetic acid negative; indican, negative.

Microscopical Examination.—A few urates and epithelial cells, and very few leucocytes are seen. No casts nor red blood cells. Twenty-four hour urine is 1050*cc* in amount; 1018, sp. gr., with other characteristics same as above.

Blood:	Hæmoglobin	90% (Talquist)
	R.B.C	5,400,000
	W.B.C	10,000 (Average on two different occasions.)

Differential:

Polymor	53 %
Sm. Mon	26 %
Large Mon	16.5%
Eosinophiles	2.5%
Basophile	1 %
Transi	1 %

200 cells counted. No abnormal R.B.C. seen; coagulation slightly prolonged 7 mins., control 5 mins. (on glass rod at normal temperature).

Feces.—No ova or parasites seen; a few undigested vegetable fibers; no starch or meat fibers seen.

February 5th. Dr. Dabney requested to examine patient's nose, throat, and ears. Reported small tonsillar tag on right side which contains pus which on culture has grown the streptococcus viridans.

Dr. Hough reports cerebrospinal fluid negative in all respects. Blood Wassermann negative. Dr. Christy reports X-ray of teeth and sinuses shows no evidence of infection or abnormality, that "examination of the chest shows rather marked infiltration at both hila and some thickening along the main trunks, extending to the lower lobes of both lungs. The appearance is that of an inflammatory process beginning at the hila. The exact nature of the process cannot be stated, but the appearance is not that of tuberculosis." Von Pirquet negative.

February 7th, tonsillectomy.

February 10th, W.B.C. 12,600.

February 12th, W.B.C. 8,600.

February 14th, W.B.C. 8,400.

February 16th, W.B.C. 10,000

February 18th, fresh hemorrhage in retina of right eye.

February 20th, W.B.C. 8,600.

The retinal picture being typical of a local tuberculosis (in spite of the infected tonsil and the negative Von Pirquet) on February 29th tuberculin (O. T. human type) 0.5*mg* subcutaneously. Slight general and local reaction. March 4th, tuberculin 1.25*mg*. Marked general, focal, and local reaction. Since that time, therapeutic doses of tuberculin have been given twice a week, beginning with $\frac{1}{10000}$*mg* (TR) and increasing the dose each time by $\frac{1}{10000}$*mg*. The condition is improving and the patient feels that the vision is clearer.

Since the second provocative injection there have been no more observable fresh retinal hemorrhages, and the white areas of infiltration have cleared up markedly. Although the patient was in splendid condition before, he has gained ten pounds, and he is feeling most hopeful about the future outcome of his case.

To illustrate another type of tuberculosis of the retina, the following case is cited briefly.

On January 7, 1920, Mrs. P. W. B., 26 years of age, consulted the writer. She was rather thin and anæmic. All of the tests made at her home had been negative except for the report of a chronic cholecystitis. Dr. W. S. Franklin wrote:

> "Right fundus: Nerve head slightly blurred, nasal margin. Numerous grayish streaks follow the peripheral arteries some of which are obliterated. In the lower quadrant, two large masses of exudate are suspended respectively 3 and 5*mm* anterior to the retina. Left fundus: Nerve head clear. Five grayish streaks following the ora serrata (nasal side)."
>
> R. E. V. = $\frac{20}{40}$; L. E. V. = $\frac{20}{20}$.
>
> On January 27th, the following report was received from Dr. J. W. Lindsay: "Gave injection $\frac{1}{10}$ *mg.* of $\frac{1}{1000}$ O. T. Several hours later, chill, general pains, headache, nausea, faintness, local soreness at site of injection, temperature reached 102.4°." There was also an increase of the local disturbance particularly in the right eye. The patient returned to her home with suggestions in regard to hygiene and therapeutic administration of tuberculin. The mother of the patient wrote recently that the daughter's last visit to her oculist "encouraged us all. He reported a very marked improvement in the condition of the eyes, said the white streaks were rapidly disappearing, and he was convinced that we were on the right track." This case differs from the previous one in several particulars —the general condition of the patient (a young woman) was very poor; the arteries were attacked primarily; the retina was clear of hemorrhages.

However, cases of recurrent retinal hemorrhages are not all of tubercular origin. The writer saw a healthy young man of twenty-four years of age some eight years ago, whose vision was reduced to $\frac{1}{200}$ from recurrent hemorrhages in the vitreous. All sources of infection in this patient were excluded except the teeth and the intestinal tract. The patient, however, suffered markedly from constipation and had a bad case of pyorrhea alveolaris. Upon the removal of the source of infection, within seven months, the vitreous entirely cleared up, leaving a normal vision. There has been no return of the hemorrhages.

There is only one more type of toxæmia that there will be time to speak of even briefly—the eye lesions which can follow anti-typhoid inoculations. A careful study of this type of toxæmia is of great importance owing to the far-reaching economic and medical values of the inoculations themselves, and also because it is not recognized generally that there is a possibility that affections of the eye may occur after the inoculations.

That the involvement of the eye is not generally realized is illustrated by the following statement of Lt. Col. H. J. Nichols, M.C., U. S. A., quoted by Dr. Phinizy Calhoun: "No doubt slight effects could be found in certain cases, as the eye undoubtedly will share in some of the general reactions, but I do not believe that these effects on the eye can be of much importance, as among the vast number of men who have been inoculated and followed up in the Service we have no records of any specific damage to the eye as the result of typhoid inoculations, and so far as I know, there is no specific lesion in the eye during a course of typhoid." In his article, "Ocular Complications Due to Typhoid Inoculations," Dr. Calhoun reports five cases occurring in the course of typhoid inoculations, three occurring in the Service and two in civil practice. In every case, the trouble occurred after either the first or second injection. Two of the cases suffered from uveitis and three from iritis; one gave a history of previous gonorrheal infection; in one there was a + Wassermann. The ages of the patients varied from 20 to 40 years.

In discussing this paper, Dr. George H. Bell reported a case of double deep keratitis following anti-typhoid inoculations.

Dr. Walter B. Lancaster stated that he had not seen a case of uveal inflammation following these inoculations but that he had recognized over twenty cases of neuropathic keratitis. Altogether, iritis, uveitis, chorioretinitis, retinal hemorrhages and lesions of the cornea have been found to be aftermaths of anti-typhoid injections. Dr. Calhoun quotes de Lapersonne's advice: "that it would not be advisable to inoculate syphilitic, tuberculous, or arthritic patients who have had lesions of the uveal tract especially after the fortieth year."

In view of the rather scant literature upon the subject, the report of the case of a patient who has recently consulted the writer, may be of some interest.

P. E., 23 years of age, had served two years in the navy. He was not inoculated upon entrance into the Service, but he was given a lipo-typhoid injection upon his discharge March 22, 1919. He gave a history of a right-sided mastoid three years ago, removal of tonsils in January, 1917, and extraction of bad teeth and scraping of bone fourteen months ago. At the time of the inoculation, there was a history of a cold with evidently a sinus involvement. Immediately after the inoculation, there was a general reaction. The right eye became badly inflamed. As the inflammation disappeared, patient noticed that there was a central blind spot. Shortly afterwards, he began to have trouble with the left eye—seeing "whirligigs," etc.

Present examination, R. E. V. = $\frac{10}{200}$ eccentric; L. E. V. = $\frac{20}{15}$. Pupillary reaction normal. Left eye color sense normal, light sense normal, fields for white normal. Interlacing of color fields. Blind spot markedly enlarged. Fundus of right eye, a central spot of chorioretinitis surrounded by small hemorrhages. In the left eye, two small peripheral spots of chorioretinitis, each one adjacent to a retinal artery. Dr. Joseph H. Bryan reported: "Marked chronic bilateral maxillary sinusitis with an acute exacerbation; deflected septum to right which interferes with drainage from right sinuses. Operation indicated." That this eye condition was due to the inoculation, is reasonably probable from the fact that a marked general reaction followed, and that the eye complication occurred immediately after the injection.

It is difficult to explain why this immunizing treatment is followed by eye lesions in some cases and not in others. However, one may conceive that the occurrence is explained by the varying age of the solution, the general lowered resistance of the subject at the time, and the sensitization of the eye tissues by some pre-existing toxæmia. In this case, the long-standing sinusitis furnished the necessary sensitizing medium.

In reviewing the literature of the toxæmias in the light of one's own experience, there are some facts that stand out with especial prominence; and Dr. Barker's advice to the internist is equally valuable for the ophthalmologist in his search for the cause of some obscure ocular affection. He says: "In looking for focal infections, I think the practitioner will be helped if he remember that most often in children the primary focus is in the tonsils or adenoids, and that in older people it is more often the teeth, paranasal sinuses, or the gall bladder."

However, the source of infection is often a mixed one, such as a combination of teeth and tonsils, tuberculosis with cholecystitis, etc. Certain portions of the intestinal tract, with its abundance of lymphoid tissue, serve as important sources of toxins. Whether this is primary, or secondary, to sepsis in the mouth or throat, it must be investigated in every case.

No part of the eye is immune from the possibility of damage from some toxic process in a distant part of the body. It is the writer's conviction that improved laboratory methods will show that the relationship between lenticular opacities (even in older people) and some focal infection, is a closer one than is now believed to exist. The writer has recently seen a number of cases of an interesting group, the ages of the patients varying from 32 to 40 years, all cases showing the common feature of a milky-looking lens, a discolored iris, and an increase, or marked decrease, in intraocular tension. The apparent cause of the original low-grade uveitis in these cases has been oral or tonsillar sepsis, or both.

Pathological conditions of the organs of internal secretion—though secondary to some distant source of toxæmia—have an important bearing upon some types of inflammation of the uveal tract.

In some cases of retinal hemorrhage in people over fifty years of age, some focus of infection, as the teeth or tonsils, gives an ophthalmoscopic picture resembling an arteriosclerotic process. But the hemorrhages and white degenerative plaques clear up remarkably after the complete removal of the septic source. This improvement is often accompanied by a lowering of the general arterial hypertension.

It is very necessary for the ophthalmologist to be able to interpret in a general way the X-ray findings in regard to the teeth, so that he may coöperate with the dental surgeon by advising the best method of procedure in dealing with certain types of oral sepsis. For example, when there is an apical abscess at the root of a surviving molar that is being used as a pivot for bridge work, the ophthalmologist must be able to decide not only that the eye lesion is sufficiently serious, but that the picture is sufficiently clear-cut to warrant the sacrificing of that important tooth. There is a tendency in one school to extract all suspicious teeth, while the opposite school depends too much upon expectant treatment. It is well to remember that in the case of the eight upper central, and the six lower central, teeth, apical abscesses can be removed and the teeth saved by the surgical procedure of root resection.

In adults, the only reliable test for ocular tuberculosis is the subcutaneous injection of tuberculin—preferably old tuberculin. The temperature should be taken every two hours for two days before the first diagnostic injection; and it is also important to have an X-ray of the lungs. In all cases, it is the part of wisdom to make the first injection small. This is especially true in acute lesions involving the retina or choroid. In adults, the first dose should not be over .5*mg.* O. T. At the end of four days if there has been no positive reaction, 1.25*mg.* may be given. It may be necessary to increase the dose to as much as 5*mg.* before one can be satisfied that the test is really negative. Following the injection, while the general and local reactions are being watched, the eye must be carefully observed for a positive focal reaction. The necessity of giving very small curative doses at the start, is emphasized by all ophthalmologists of large experience. In most cases, the therapeutic injections of tuberculin are very efficacious when accompanied by the proper regimen and hygiene.

In typhoid inoculations in civil practice, it is wise not to give the inoculations as long as there is any evidence of the existence of any focal infection.

In past years, many ocular inflammations were considered syphilitic when the etiology was not very clear, and the affection yielded to anti-syphilitic treatment. But it is a clinical fact that often non-syphilitic lesions of the uveal tract are favorably influenced by anti-syphilitic treatment. Also, long protracted lesions are helped by the administration of the extract of certain glandular organs—such as the thyroid extracts. However, the contrary is also true. The writer has seen a few very severe cases of plastic uveitis following large doses of thyroid extract self-administered for the reduction of flesh. In every case the general nutrition suffered severely with the rapid reduction in weight.

When the leucocyte count is high, the successful elimination of some of the toxic sources is indicated when the repetition of the count shows a reduction.

In some of the writer's cases that exhibited very severe oral sepsis, there has been an increase in the protein content of the spinal fluid without any other detectable cause for this increase. This clinical fact suggests the possibility that the toxins may enter the central nervous system either along the lymphatics of the nerve sheaths or through the blood stream itself. The resulting irritation might account for the increased protein, whether the cerebrospinal fluid finds its source in the general serous cavities—as Dr. Dercum believes—or in the choroid plexuses.

Whatever may be the etiology of the ocular expression of the toxæmia, there are certain principles of therapeutics that assist nature in rehabilitating the injured tissues. The first, of course, should be the eradication of all toxic sources; then a simulation of nature's own measures by bringing increased numbers of leucocytes to the "zone of activity." This may be accomplished by the local use of hot applications and, at certain stages of the inflammation, dionin and subconjunctival injections of normal salt solution. It is obvious that nearly all involvements of the anterior portion of the uveal tract will require the local use of atropine. At the same time any deficiency in the secretion of the glandular organs should be supplied by the proper organ therapy. Dr. Rogers ingeniously suggests the possibility of the patient with hypothyroid disturbance being unusually susceptible to atropine when the least bit fatigued, owing to the failure both of the vagus and the sympathetic systems. In the case of retinal hemorrhages, accompanied by a prolonged coagulation time, the use of the lime salts is indicated. In all toxæmias, in addition to the suggestions regarding hygiene, the gastro-intestinal tract must receive attention both in regard to diet and therapeutics. The writer would emphasize strongly the application of these measures while the source of the toxin is under investigation.

In 1892 the great Lister, in his words of appreciation of Pasteur, said: "You have raised the veil which for centuries had covered disease; you have discovered and demonstrated their microbian nature." In the wonderful soul of Pasteur was born the spirit of the renaissance of scientific medicine. With his lifting of the veil that obscured the nature of disease, the ensuing years will bring a fuller knowledge of the life histories of bacteria, of the bio-chemical changes going on in the body during health and disease and of the pathological alterations of the endocrine organs. The application of this knowledge will result in the discovery of the often unsuspected sources of chronic toxæmias, and in their elimination before damage can result to the joints, the muscles, the heart, or the sight. Prevention rather than cure, approaches more nearly the goal of all medical efforts—the eradication of disease. And the words of Disraeli are as applicable to the future as they were to the past:

"Public health is the foundation on which reposes the happiness of the people and the power of a country."

ILLUSTRATING DR. GIFFORD'S ARTICLE ON "FUSIFORM BACILLI ON THE CONJUNCTIVA AND IN THE MEIBOMIAN GLANDS."

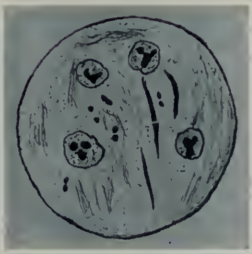

FIG. 1.—Smear from Case I. (The bacilli stained pink with carbol-fuchsin and showed only faintly in negatives. Attempts to restain with gentian-violet deposited so much debris that a clear photograph could not be taken.)

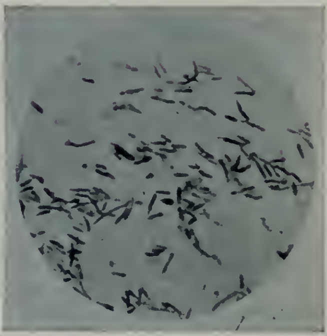

FIG. 2.—Three-day agar culture from Case II.

FUSIFORM BACILLI ON THE CONJUNCTIVA AND IN THE MEIBOMIAN GLANDS.

By Dr. SANFORD R. GIFFORD, Omaha, Nebr.

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(*With two illustrations on Text-Plate X V.*)

IN view of the increasingly recognized prevalence of trench mouth or Vincent's angina, it seems worth while to report the occurrence of fusiform bacilli morphologically very similar to those found in this condition, in two unusual locations.

Case I. was a woman of 42 who showed a peculiar ulcer surrounding her left lower tearpoint. A year before, Dr. Vercoe had removed a small concretion from the left lower canaliculus of which no smears were made. Since that time, she had noticed this peculiar appearance around the tearpoint but had suffered no pain from it, and only came into the office for the removal of a foreign body, which was found on the left upper tarsus. It was then that the unusual ulcer was discovered. It was covered with a thin whitish membrane, and on touching with a probe, the tissue around the tearpoint was found to be softened to a depth of about three millimeters so that a little pocket of softened tissue was formed around the canaliculus. The continuity of the canaliculus, however, was uninterrupted, as fluid could be injected through the punctum into the nose. The patient suffered no pain from the ulcer and lacrimation was only slight. Since an ulcer of this appearance and location was new in my experience, smears and a culture were made. Smears from the membrane showed a mixture of organisms such as is often found in ulcers of the pharyngeal mucosa. There were Gram-positive diplococci and a fairly large number of long irregularly shaped organisms, mostly Gram-negative, some with tapered ends, large in the middle and of a definitely fusiform appearance. A few showed the typical arrangement in pairs with the thicker ends together, the more tapering ends in opposite directions, shown by the fusiform bacilli in Vincent's angina. The granules staining deeper by Gram which have been noted and which I believe are one of the most characteristic marks of these fusiform bacilli were not seen, but the counter-stain in this case was unusually deep. There were a few longer, more slender Gram-negative fibrils, curving irregularly and a very few whose curves made them appear like rather atypical spirilla, but these may have been fibrin and it cannot be said that spirilla were present (see Fig. 1). The culture was overgrown by a Gram-positive spore-bearing bacillus and no fusiform bacilli could be found, only the spore-bearer and staphylococci. Since the patient was having no symptoms, only a mild zinc collyrium was prescribed and she was asked to return in a few days. She did not return until six weeks later, in response to a note, when she stated that for two weeks after her visit she had suffered with what seemed to be an acute conjunctivitis, with swelling of both lids. This had cleared up and now the ulcer was completely healed, showing only a slight flattening and tenseness of the mucosa around the tearpoint, which was patent. There was no watering and the eye felt and appeared normal. Whether the acute attack bore any relation to the ulcer is hard to say. It may have been an acute conjunctivitis due to some other infection introduced with the foreign body which was removed.

Case II. was that of a seven months old baby whose left eye showed an extreme condition of chalaziosis. Both lids were fairly riddled with chalazions, of which there were at least fifteen, mostly small ones, in either lid. The cornea and ocular conjunctiva were normal. The right eye showed two small Meibomian concretions of the upper tarsus which were removed, but was otherwise normal. Dr. Harold Gifford opened and curetted out all the more considerable chalazia, obtaining a yellowish semisolid purulent material. Reports from the parents state that one month after operation, the baby's lids still become somewhat inflamed at times, and that small areas of swelling appear, which resolve without forming pustules. Two months later, they state that the lids are to all appearances normal. Smears of this purulent material showed pus cells and debris of broken down cells. There were a few round single spots staining Gram-positive which might have been taken for staphylococci, but as no staphylococci grew in the culture, they were considered as debris or precipitate of the stain. The smears were destroyed before the cultural findings were obtained which would have urged a more thorough examination. Smears of pus, which was left on the agar slant twenty-four hours, however, showed many bacilli like those to be described.

Culture on plain agar showed in twenty-four hours a well-marked clear yellowish growth along the needle track. On smears, it proved to be a pure culture of a peculiar fusiform bacillus, thicker at the centers, with tapering points, some arranged in pairs (see Fig. 2). Most of the organisms were markedly Gram-negative but a fair number showed two to four Gram-positive spots near the center and a few organisms were completely Gram-positive. Some showed a less marked spindle-form, but the generations from a single colony on a plate showed a great predominance of the spindle-form, so a pure culture was evidently obtained. The bacilli showed independent motility, often of a tumbling, twisting type.

The organism grew fairly well at 37 degrees centigrade on all ordinary media, very slightly at room temperature. On agar the growth was rather characteristic, being shiny, slightly raised with rounded edges, and remaining always much more transparent than the growths of most other Gram-negative bacilli. The colonies were clear, round, and discrete, resembling meningococcus colonies but growing slightly more yellowish. In broth, it produced little balls of flocculent sediment which formed a mass at the bottom of the tube, leaving the broth clear. Litmus milk was slowly turned a deep bluish-purple but its consistency was unchanged except for a similar sediment. On blood plates, the colonies produced a small ring of complete hemolysis. No odor ever developed in the cultures. It produced no gas in sugar media.

In cultures three or four days old, a large number of disintegrated bacilli and involution forms were found, some of which were threads eight to ten microns long. At this time, also, clear spore-like terminal bodies were seen, some of which stained by Moeller's spore stain. After boiling for 1½ minutes, it was still capable of transfer, so evidently true spores were formed. No spirilla were ever found in culture.

Two intraperitoneal injections in guinea pigs were without positive results. One pig died in seven days but the organism was not recovered so death may have been accidental. Two injections in the vitreous of guinea pigs were positive. One showed a well-developed vitreous infection after four days with cloudy cornea and peri-corneal injection. After six days, the reaction was diminishing, leaving an opaque mass in the vitreous. At enucleation seven days after injection, the vitreous was turbid and a fair number of fusiform bacilli were found in smears. A few were found in cultures but they were overgrown by a contaminant. The second guinea pig showed evidence of panophthalmitis the day after injection, which was somewhat decreasing in severity at time of enucleation six days after injection. The turbid vitreous showed many fusiform bacilli and three cultures from the vitreous showed them in pure culture. Both animals lived, and aside from some loss of weight, showed no general effects.

In comparison with the fusiform bacilli of Vincent's angina, the present organism showed a great predominance of Gram-negative forms, much greater than I have usually observed in smears of Vincent's angina, but as elsewhere noted smears from different cases vary within wide limits in this respect. In cultures, Weaver and Tunnicliff and others have found them Gram-negative except in the dark spots they describe. The bacilli were also thicker at the center than most of the organisms seen in smears of Vincent's lesions. The characteristic granules were seen in both organisms.

Dr. Tunnicliff, to whom I sent a culture of the organism from Case II., very kindly examined it for me and gave as her opinion that it is not bacillus fusiformis, though it is fusiform in shape. She notes that bacillus fusiformis is an anaërobe with an offensive odor and more slender than this organism in culture. She thinks the term bacillus fusiformis is being used to designate several different bacilli.

Certainly bacillus fusiformis has always been reported as at least a relative anaërobe. As Dr. Tunnicliff notes, however, it may grow aërobically in mixed culture. Krumwiede and Pratt (10) and others have noted their growth on aërobic plates with pyogenic cocci. One may conceive of aërobic forms of such a little known organism, as one knows of anaërobic forms of streptococci. Though this probably is not the same organism as the bacillus of Vincent's angina, its being

Gram-negative, and its rather uniformly fusiform shape seem to me to exclude it from the diphtheroids, and there seems to be no organism with whose morphology it so nearly coincides as bacillus fusiformis. I would place it, then, as at least a related organism, in the still somewhat undefined group of fusiform bacilli.

Literature.—Aside from their frequent presence in lesions of the tonsils and gums, the presence of fusiform bacilli in lesions of many other parts of the body, both with and without spirilla, is becoming more widely recognized of late years. Their occurrence in noma, usually with the spirilla, but occasionally without them, is well known. Weaver and Tunnicliff (1) have summed up the literature on this form of infection, Dick (2) found fusiform bacilli at seven post mortems in six different lesions, two from the meninges in meningitis, and one each from cerebellar abscess, gangrene of the lung, pneumonia, empyema, and peritonitis. Three of these strains were cultivated. In most of these cases, pyogenic cocci were found with the fusiforms, but no spirilla. Vincent (3) in 47 cases of hospital gangrene, found them with spirilla in 40 cases, without spirilla in seven. Veillon (4) found them without spirilla in several cases of appendicitis. He grew them in pure culture, and injections of this produced small abscesses in guinea pigs and rabbits. Schmidlechner (5) reports a case of fatal puerperal sepsis in which he found fusiform bacilli and spirilla in smears from deep ulcers on the nymphæ and vagina and from necrotic material in the uterus. He mentions Matzenauer's having found it in gangrenous ulcers of the female genitalia and that Róna found it in many such cases, describing a deeply destructive form of lesion resembling noma of the mouth. Beitzke (6) in a thorough review of the literature up to 1904, mentions its occurrence, usually with spirilla, in gangrenous laryngitis (Bernheim and Pospichill), antrum infection producing, in one case—fetid bronchitis with metastatic abscess of the thigh (Lichtwitz and Sabrazés) and in the dysenteric movements of a dog (Niclot and Marotte). The author found a fusiform bacillus at post-mortem in smears from the ulcerated gum, alveolar abscess, larynx and large and small bronchi of a case of broncho-pneumonia.

Dr. James R. Miller of Hartford, Connecticut, tells me of finding many fusiform bacilli and a few spirilla with pyogenic cocci in an abscess at the base of the brain at post-mortem. The abscess was secondary to an alveolar abscess. Dr. E. G. Cary of Omaha says he has seen one case of what looked like a primary lesion on the glans which showed a profusion of both organisms and was found not to be luetic. Mellon (13) saw a case of gangrenous balanitis in which fusiform bacilli seemed to be the causative organism. Though usually producing only local lesions by direct extension, that fusiform bacilli can enter the blood stream and produce metastatic abscesses is shown by Feldmann's case (7). Babes (9) describes a case of infection with a fusiform bacillus which differed from the usual type in growing aërobically. At post-mortem on a child who died eight days after birth, apparently of general infection from an infected navel, he found in smears of the blood and viscera slender bacilli with pointed ends which grew alone in nineteen out of twenty-one aërobic cultures from different organs. It was pathogenic for rabbits and guinea pigs. The small, shiny, transparent colonies becoming yellowish in older cultures which he describes seem to indicate a great similarity to the organism described in Case II. of the present report. Mellon (13) has recently described a fuso-spirillary organism isolated from the blood, pleural fluid, sputum, and renal abscess of a case. From the great variation in forms observed, the identity of this organism with previously described fusiform bacilli is somewhat questionable. His organism apparently formed true spores and was an anaërobe.

I could only find two reports of the occurrence of fusiform bacilli in the eye or adnexa. Bertozzi (8) obtained them in smears and cultures from an eye lost by metastatic ophthalmitis. The patient was recovering from an attack of measles. There were apparently no other metastases found. The fusiform organisms were described as Gram-negative with granules. Wakisaka (14), reporting on the bacteriology of dacryocystitis, mentions finding "bacillus fusiformis vincenti" in one case associated with bacillus influenzæ, but no further details were given in the review consulted. Ichikawa (15) suggests that the fuchsinophil bodies which he found in sections of five out of seven cases of sympathetic ophthalmia may be bacillus fusiformis, but thinks they are more probably crystals.

Discussion.—It is seen that most of these infections were of the respiratory or alimentary tract, explainable by the aspiration or ingestion of inhabitants of the mouth or gums. From the frequency with which they are found in diseased gums, it is evident that fusiform bacilli are common in the mouth. The fact that Babes (9) found them on the gums of a large number of cases of scurvy makes it probable that they are normal inhabitants of many mouths and that they may take advantage of conditions of lowered resistance or neglect of cleanliness either to produce disease or live as saprophytes on diseased tissues. That they have been found as the only organism without the presence of spirilla, in so many different lesions and in the deepest layers of the lesions, indicates that they may, under certain conditions, be pathogenic organisms of importance without the concurrence of spirilla. Whether there is only one bacillus fusiformis or several related organisms has not been definitely determined.

That fusiform bacilli are common inhabitants of the conjunctival sac is unlikely. The examination of numerous smears and cultures has never before shown any organisms suggesting to me their appearance. There is no reference to them in Axenfeld's *Bacteriology of the Eye* (11) nor in Harman's *The Conjunctiva* (12). The possibility that they may have reached the conjunctiva in these cases through the naso-lacrimal duct is made more likely by the fact that they are actively motile. But it seems at least as likely that they may enter the sac from the outside, possibly in the droplets from another person's pharynx, and find lodgment in the canaliculi or Meibomian glands.

Hearty thanks are due to Dr. J. T. Myers of the University of Nebraska for going over this material with me.

Conclusions.—1. Fusiform bacilli were found in smears from an ulcer surrounding a canaliculus in one case. They seem by their morphology and from the type of the lesion to be closely related to the bacilli of Vincent's angina.

2. Fusiform bacilli of a somewhat different type were grown in pure culture from the pus of a second case of unilateral chalaziosis. They grew aërobically and, though probably not the same organism as that of Vincent's angina, seem to belong in the group of fusiform bacilli with Babes'

organism. They produced infection of the vitreous in guinea pigs.

3. Whether they were the causative organisms in either case or only secondary invaders, cannot be definitely stated.

BIBLIOGRAPHY

1. WEAVER and TUNNICLIFF. *J. Inf. Dis.*, 1907, iv., p. 8.
2. DICK. *J. Inf. Dis.*, 1913, xii., p. 191.
3. VINCENT. *Ann. de l'Inst. Past.*, 1896, x., p. 490, 1905, lvi., 291.
4. VEILLON. *Arch. de Med. Exp.*, 1898, p. 517.
5. SCHMIDLECHNER. *Zeit. f. Geburts. und Gynäk*, lvi., 2.
6. BEITZKE. *Cent. f. Bakt.*, 1904, xxxv., p. 1.
7. FELDMANN. Quoted in Bertozzi (8).
8. BERTOZZI. *Ann. di Ottol.*, 1907, xxxvi., p. 138.
9. BABES. *Kolle und Wassermann's Hdbch. Ergänzungsband*, I., i., 1906.
10. KRUMWIEDE and PRATT. *J. Inf. Dis.*, 1913, xii., p. 199, and xiii., p. 438.
11. AXENFELD. *Bacteriology of the Eye*, Trans. MacNab, New York, 1908.
12. HARMAN. *The Conjunctiva*, New York, 1908.
13. MELLON. *Am. Jour. Bact.*, Sept., 1919, p. 505.
14. WAKISAKA. Rev. in *K. M. F. A.*, xlvii., p. 797.
15. ICHIKAWA. *Am. Jour. Ophth.*, Jan., 1919.

THE EYE AND THE ENDOCRINE SYSTEM.[1]

By Dr. PERCY FRIDENBERG, New York.

THE biological reaction to disease and drugs that distinguishes a patient from a case, closely parallels his attitude toward life, and forms with it, personality. It is the subtle something which makes one run temperature, stand fever badly, take large doses of one drug, and be upset by minute amounts of another. Like resistance to infection, fatigue, and cold, worry and fear, it could not always be explained by stature, frame, or complexion. The recognition of such an individual factor and the need of a biological explanation appears in the earliest thought about disease and healing. To primitive man the essential ego was not cerebral, intracranial, but visceral, near the seat of life; the spirit, essence, psyche, was associated figuratively as well as literally with guts and gall, with a heart, a spleen, a kidney. The idea was incorporated in early phrase and fable, some of which has come down to our more scientific and equally searching age. Varying, in classic ages with the divinities which shaped his ends, or in medieval times with the planets which ruled their destinies, men, as well as medicines, were Jovial, Martial, Mercurial, Saturnine. Varying, later with current views or speculations as to man's spiritual and bodily make-up, philosophers, lay and medical, distinguished organic secretions or humors, producing dyscrasies, idiopathies, and special reactions to sickness, health, and the healing action of herbs, according as they were phlegmatic, sanguine, lymphatic, atrabilious, choleric. Cellular pathology discarded all this apparently mystic speculation, but Virchow's somewhat mechanical view of the organism as a histological specimen, was superseded by serology and enriched by its bio-chemical conceptions. To-day, again, we see a biological basis for the personality of the patient. It is, however, no longer a single humor which decides, but the balance or predominance of a number; not an organ, but an orchestra. So, of recent years, there has been an attempt to correlate the data as to the functions and biological bearing of the ductless glands, those organs of internal secretion which form the neuro-endocrine or chromaffin system. Pathological and clinical study, animal experimentation, and biological research, indicate beyond question that this system is a basic factor in structure, function, and immunity, determining skull and body form, complexion, color, stature, hair-growth and fat distribution, and emotional and spiritual trend which we sum up as race or individuality. The ophthalmological implications of this principle are interesting and worthy of study.

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[1] Read at meeting of the American Ophthalmological Society, June, 1920.

The division of mankind into long-skulled and short-skulled seemed to give a definite anatomical basis to ethnological categories. However, it never occurred to the anthropologists to ask themselves why skulls differ and what caused them to differ. The influence of skull and particularly orbit form on the structure and refraction of the eye was summed up in the theories of Stilling and others, but the racial differences were accepted without question as to the biologic factors involved.

Endocrinology shows us that the main factor is the predominance of the thyroid or of the pituitary. The pituitary type is characterized by a broad short skull and proportionately broad face, separated incisors, broadly spaced, deep-seated and small eyes which lack brilliance and vivacity, and have rather small pupils. The brows are heavy, the glabella broad and flat, the nose, broad with large, wide nostrils. Such a skull has large accessory sinuses, roomy sella turcica and orbits, large optic canals and foramina. The hair is coarse and sparse, the skin sallow, harsh, dry, brown, and of poor texture.

In myœdema this relative hypo-thyroid condition is accentuated and becomes physiognomic, presenting a small, recessed eye, whose lack of animation is due to a small pupil, slow ocular movements, and partly closed lids. The development of the cranium in the neighborhood of the sella turcica and of the orbit is affected in steeple skull, associated generally with optic atrophy, and in these cases endocrine stigmata of acromegaly are not lacking. These pituitary types are also gonadal, adrenal; they lead, quiet, unruffled, contemplative lives, moving slowly but persisting in one line of endeavor, they sleep much, are sluggish, lazy, constipated, and live long. Hands and feet tend to spatulate form. The type is marked in such races as the negro, the Chinese, Polynesians, and Mongols. The hyper-thyroidic eye is sympathetico-tonic, exophthalmic, mydriatic, wide-eyed, hyperæmic, alert, sparkling, tending to red lips, conjunctival hyperæmias, epiphora, and fleeting palpebral œdemas. The expression is that of excitement, or when extreme, of fright, as seen pathologically in the clinical picture of Graves's disease. These types are temperamental, high-strung, emotional, artistic, unbalanced, live at high pressure, and consume themselves. They have a high basal metabolism, rapid heart action and respiration, flush easily. There is over-activation in every sphere. These are the dreamers, the poets, the artists, the feminine sensitive types, changeable in spirit and vocation, moody, inspired at times, witty, imaginative. They are the rhapsodists, never the judges or statisticians. They supply the contingent of the neurotics, the speech-defectives, the visionaries and cranks. They react quickly to all medicinal and morbid stimuli, tend to active inflammatory conditions, high fever, and definite symptoms. They have a quick acting gastro-intestinal tract, tend to nausea and diarrhœa, and are poor sailors; get rattled and panic stricken, lose their nerve on slight provocation, and make poor soldiers. Generally dolichocephalic, narrow-faced, narrow or olive eyed, with narrow high bridged nose, arched slender eyebrows, thin in the outer third, myopic, tending to bookishness. They have fine skins and hair, high color, turn gray early, are prone to baldness at an early age, and lose their lashes when young. Types, Semitic. Color was always looked on as a criterion of race; but here again ethnology accepted the red, the yellow, the white, and did not ask why and how these skin differences were caused. Something more than meteorological or climatic effects are needed to explain the geographic distribution of the races, either in frigid or torrid zones. Color referred, preëminently to skin, hair, and iris; blonde meant blue-eyed and golden haired.

Here, one thinks of the important role of pigment in the ocular tissues, particularly uvea and retina, the dissociation of pigment in the chemical reaction to light in visual stimuli. Pigment production, distribution, and fluctuation in health and disease is controlled largely by the adrenals. The plus or minus in an individual is an index of his adrenals, and to a certain extent of his disease habitus or susceptibility. Such conditions as albinism or, again, of retinitis pigmentosa, must have their adrenal explanation. Pigment develops under the influence of light, the source of all energy, and may be noted in all deposits or storage of force, as in coal, chlorophyll, iron, and blood. It is never destroyed, however transported and rearranged, as in freckles, melanomata, choroiditic patches. The relation of pigment to vital energy is suggested by the difference in resistance, the susceptibility of fair, delicate, lymphatic, blonde races to tuberculosis, and the hairy growth, thick brows, and heavy beards of swarthy brunette Hindus and Latins. Degenerative changes in the skin attending senility, chronic disease (diabetes, attenuated syphilis, malaria), or disturbances of metabolism, are of endocrine, generally hypo-adrenal origin. One thinks of the age incidence of xanthelasma, notably about the lids, and its frequent occurrence in diabetics; the appearance of xeroderma pigmentosum under the influence of the syphilitic virus. The retina bears out an analogy to the skin, in its ectodermal origin, and important pigment layer. Anomalies from syphilis are found in this tissue, retinitis pigmentosa, probably too in the hemeralopia of wasting disease, vitamine deficiency, and various toxæmias. Albinism, again, with its striking endocrine stigmata, is suggestive, as is the tendency to loss of eyebrows and lashes.

Age and sex, development of form and of function, are largely controlled by the endocrines, whose balance and interrelations vary with the biologic needs of the organism in puberty, adolescence, pregnancy, lactation, and the climacteric of both sexes. Each period has its distinctive endocrine dominance which may have pathological implications in regard to the eye. Thus, the relapsing intraocular hemorrhages of adolescence, male and female, ascribed to an occult tuberculosis which the tests generally fail to reveal, is explainable on the basis of the predominance of the thyroid at puberty, and its activating influence on the vascular system. The vicarious menstruation of an earlier medical epoch is similarly interpreted. At the other end of life the relative hyper-thyroidism associated with the dying down of internal secretion, ovarian or gonadal, is responsible for various neuro-vascular syndromes, which were formerly summed up as neurotic. The obstinate epiphoras, hyperæmias, and occasional fleeting œdemas are characteristic of this period. Headache is often an endocrine disturbance, and while the importance of ametropia, muscle imbalance, and accommodative strains till holds good, the fact remains that some individuals never get headaches in spite of these factors, and others continue to suffer in spite of painstaking correction of minimal optical errors.

Emotional stress has in a vague way been associated with causes of disease. Our view of such reactions has largely changed, and they are now considered secreto-genic, biologically, while originating, it is true in impulses derived from sensory stimuli, and pro tanto, psycho- or neuro-genic. Hate, fear, anger, desire, are diffuse somatic ractions of a neuro-vascular type affecting the vegetative even more than the volitional spheres, and not infrequently remaining below the threshold of consciousness. At this level they are, however, tremendously active, and affect the basic processes of circulation, respiration, and digestion, and, indirectly, growth, resistance to fatigue, cold, and hunger, and probably such reactions as immunity, anaphylaxis, and phagocytosis. The internal secretions are poured into the circulation automatically under the stress of elemental urges such as hunger, desire, rage, fear, cold, and pain. What we call emotion is that part of the reaction which rises into consciousness and presides over activation of the skeletal muscles via the cranial nerves. Both reactions are purposive and eventually adaptive processes, as they represent the race memories of definite, repeated experiences and the appropriate response. The largely neuro-vascular reactions, changes in pulse rate, blood pressure, respiration, nerve and muscle tonus, as well as certain inhibitions of temporarily useless functions, are all in the interest of protection, defensive or offensive. Every emotion is a battlecry or a call for help; every reaction, a message of aid or of distress. Each emergency calls for an endocrine supply, and the end reaction depends on the amount of available internal secretion, notably of adrenalin. Pleasure is the elemental recognition of endocrine reserve; pain and apprehension that of weakness due to a lack. Rage is the memory of fighting and killing; fear the memory of flight; and fainting, that of escape by feigning death. But rage, endocrinologically, like lust, is the flooding of the organism with adrenalin to prepare for action; fear, the state of relative hyper-thyroidism due to adrenal deficiency. The ocular implications are interesting, particularly when we consider the pupil as an index of emotion and of cardiac action, and the rôle of the eye in expression. We can understand how fear and worry predispose to the angioneurotic œdema, the exudation with plus tension, and the acidosis with pain, nausea, and vomiting, that we see in the acute attack of glaucoma in a susceptible race, the Semitic, at a predisposed time of middle life when adrenalin is beginning to run low, and at times determined by cold, hunger, or fatigue. Each of these factors implies a lack of adrenal or a relative hyper-thyroidism, inherited, acquired, or developing under stress. Repeated drains on the adrenal as by worry, fear, hunger, produce a more or less permanent dys-thyroid imbalance as in neuroses. The pupil, like the heart muscle, is under double nerve control, and responds to all basic neurovascular stimuli. The oculo-cardiac reflex of Aschner, and the effect of pressure upon the globe in slowing or speeding up the heart rate, indicate in a given case the predominance of vagotonic or sympathetico-tonic system. A large part of our automatic defense reactions depend on visual stimuli, or as Crile says, our activation patterns come from sight. This, and the complex neural and cerebral connections of the organ of vision, may explain the comparatively severe shock produced by ophthalmic injuries and operations. The closest connection is with the sympathetic system, and this presides, as we know, over systemic prostration and recovery. The fullness and comparative hyperæmia of lids, conjunctiva, and orbital tissues not only influences expression and normal processes, but is significant in disease, while the vascular reactions of the iris and ciliary body are markedly dependent on visceral sympathetic control. This control is not neural in the old sense, but depends on internal secretions acting practically as alkaloids. It is significant that both agents fall naturally into two large groups, activators and depressors, respectively, of the sympathetic, or vice versa as to the vagus, with a corresponding action on the pupil, according as they are meiotic or mydriatic. The pupillomotor action of a drug was always taken as an index of its systemic action and, almost, of its chemistry. We must bear in mind that these eye-drops have reactions, secondary perhaps from the standpoint of ophthalmic therapeutics, on the endocrine system, particularly the thyroid and adrenals, and, again, are aided or counter-acted by the balance of internal secretions, already present or administered therapeutically, or indirectly altered by appropriate diet, hygiene, and climate.

Seasonal Incidence.—Such factors as prolonged cold, overcrowding, lack of fresh food, defective ventilation, explain many diseases and their prevalence at certain times. It is known that all these factors act very largely through deficiency in the endocrine system which has, itself, a seasonal ebb and flow, depending partly on climate and heat, and partly on the fluctuating needs of the organism. This like all periodicity, such as menstruation, pregnancy, hibernation, is controlled by the pituitary. The prevalence in warm weather of Saemisch's catarrh cannot be explained by purely hygienic factors. The basic process, that of a lymphoid hypertrophy, associates it in our mind with adenoids, Mikulicz's disease, and Parinaud's conjunctivitis. The eosinophilia of these affections is not the only manifestation of thyroid imbalance.

Glaucoma.—The refraction and form of the eye, topography of filtration angle, cardio-vascular pressure, the plus of ciliary secretion, do not explain, although they may account for, the increase of intraocular tension. The constitutional symptoms of headache, extreme pain and prostration, nausea are significant. Pain alone, however severe, never presents this picture of endocrine storm in other eye affections. The sudden incidence from the instillation of a drop of cocaine, emotional stress, from the shock of a trifling eye injury, again point to a sympathetic irritation. Our sovereign remedies, called meiotics, depress the sympathetic and allay this irritation. Heat, hot coffee, rest in bed, morphine, allay pain and restore the adrenaline output, thus neutralizing the thyroid overaction. The mechano-physical theory fails to explain how intra-tumors can attain large size without altering tension, and how the pupil becomes dilated and unresponsive to local meiotics while it will contract on internal administration of pilocarpin or jaborandi. We cannot fully explain why eserin fails to contract a glaucoma pupil while acting promptly on a normal iris. If plus tension alone paralyzes the sphincter, we cannot understand how the drug systemically absorbed can stimulate this muscle. Ocular angio-neurotic œdema is at times associated with glaucoma. Of his case Barkan says: "It seems too much to suppose in view of the well recognized causes of certain classes of glaucoma that all these causes should only be favoring factors to the localized œdema which raises the ocular tension. Are hyperopia, old age, stiffening of the sclerotic, disproportionate increase of lens volume, fibrosis of the ligamentum pectinatum, high blood pressure, arteriosclerosis, and sudden mental excitement, all only secondary to a local acidosis, or only an aid in its appearance? For acidosis is common in childhood, glaucoma rare; there is no œdema in diabetes, typically acidotic as it is. On the contrary, one finds hypotony in this non-œdematous highly acid state. Finally, the prompt action of meiotics especially in the case reported of angioneurotic œdema with glaucoma is hard to reconcile with the hydrophilic theory." These considerations lead straight back to the endocrine theory. First, the various histological changes predisposing to plus tension are due to the continued effect of adrenalin on the tissues, particularly of the vessel walls. Alcohol, tea, tobacco, as well as worry and overwork, and probably specific disease, act not directly, but through this endocrine medium. There is no tendency to œdema in diabetes because this is a typically pituitary disturbance with lowered metabolism. The infrequency of glaucoma in acidotic childhood is logical in view of the untouched adrenal reserve, and the infrequency and short duration of such emotional factors as tend in the long run to produce hyper-thyroidism and the glaucoma habitus. The prompt action of meiotics might be interpreted as merely symptomatic, indicating by the pupillary reaction that the underlying paralysis of the vagus had been restored, and the over acting sympathetic toned down. Glaucoma may be looked upon as an exudative process or œdema due to the sympathetic irritation of thyroid activation, as indicated by hyperhidrosis, tachycardia, nausea, susceptibility to atropin and adrenalin, or the provocative instillation of a mydriatic. It favors a hyper-thyroid race, the Hebrew, which is markedly predisposed to neuroses and diabetes caused largely by endocrine, formerly nervous, upset due, in part, to long continued emotional strain. It occurs at an age of relative hypadrenal-gonad secretion, the climacteric, male or female, and with emotional states of worry, fear, hunger, and exhaustion, which are notably connected with thyroid excess. Exophthalmic goitre has absolutely parallel ætiological implications and might well be looked upon as an alternative to glaucoma from the endocrine standpoint.

The rôle of skin affections and of gastro-intestinal disturbances is borne out by their endocrine control. In many diseases of the lids and conjunctiva we see a resemblance to eczema or urticaria, while gastro-intestinal intoxication is held as a common cause of uveitis and other eye disease. The skin is a mirror of the endocrine system, and constipation and intestinal torpor is often a purely dys-thyroid manifestation.

Metabolism.—The chemical products of fatigue as well as the endocrine secretion (thyroidin) which accompanies it, produce a salt retention which is neutralized by sweating, urination, and compensatory intake of fluids. This is completely analogous to the action of pilocarpine.

Acid retention with œdemas such as urticaria, or exudative process in mucous membranes is undoubtedly endocrine.

Ocular Neoplasma.—The age incidence is parallel with the pigment development of pre-senility and the biological period at which, body growth having terminated, and the reproductive call on gonad-adrenal secretion subsided, the potential energy of the endocrine system is diverted into an abnormal channel that of cell activation. All growth, or trophic dimensional increase, and development, or structural change to meet the needs of function, is controlled by the internal secretions, both in health and disease. In the eye, an embryological expansion of the brain, this double control must be significant. Crile says that the importance of the internal secretion of an organ may be estimated by the closeness of its relation to the sympathetic system. There is a certain metaphysical, if not clinical, sanction in considering the eye, itself, as an endocrine structure, with vagus and sympathetic control, and two obligate hormones or internal secretions, the aqueous and the vitreous. Even its external secretion, that of the tears, is largely dependent on emotional, hence endocrine, stimuli.

The endocrine may account for some congenital developmental defects. Growth, development, vital rhythm, and periodicity are all dependent on endocrines, notably the adrenal and pituitary. Further study may show a factor of this sort in lamellar cataract, and those forms of lenticular opacity developing with deficiency diseases (pellagra) or nervous disturbances (tetany). The family element and factor of consanguinity in many types of hereditary ocular degeneration may be due to summation of endocrines with the production of a pathological type. In this relation we think of Mongoloid cretinism, amaurotic family idocy, chondrodystrophia fetalis, congenital ptosis and enophthalmus, buphthalmos, the blue scleræ associated with congenital fragilitas ossium, congenital corneal dystrophies.

Congenital epicanthus occurs normally among Chinese and allied races, and as an endocrine stigma of hypo-thyroidism in infants of Aryan origin. The chorioretinal degenerations associated with inherited specific disease are doubtless dependent in the last analysis on grave disturbances of endocrine balance as, are the changes in teeth, skin, and internal ear.

Endocrinology in no way supplants, it largely supplements, our views of pathogenesis and ætiology. Organotherapy is not a panacea, nor, primarily a principle of treating symptoms. It is rather in pre-pathological states, in disturbances of normal function, in the presence of syndromes indicating enodocrine imbalance, in many minor ailments, idosyncrasies, and disease tendencies, that judiciously administered extracts of combined glands may reëstablish a balance. The field is wide and undoubtedly contains much that is interesting and important for ophthalmic science and ophthalmic practice.

MEDICAL-SOCIAL SERVICE AND FOLLOW-UP WORK IN THE EYE HOSPITAL.[1]

By Dr. GEORGE S. DERBY, Boston.

IT will be admitted by all that no hospital at the present day which serves the people can give really efficient service unless it makes provision for social service work and establishes some sort of follow-up system. The importance of this subject, and the infrequency with which it is discussed at our meetings, form the justification for this paper. Probably a large part or all of what I am about to say is familiar to most of you here, but in spite of that I wish to outline briefly the status of medical-social service and follow-up work at the Massachusetts Charitable Eye and Ear Infirmary, and to invite your criticism and suggestions.

I need not go into the history of this department, except to say that it was started in 1907 with one worker and was financed by charitable persons outside the hospital, until in 1909 it was taken over by the hospital. A certain amount of follow-up work was being done by the Social Service, but no organized effort had been made along this line until 1916, and this was interrupted by the war. In 1919, a follow-up worker was installed at the infirmary as a separate line of effort, and a year later she was placed under the Social Service Department in order to avoid the overlapping which inevitably occurred. I may say also that, as yet, our Social Service Department has not recovered from the contraction due to the war and to the loss by the hospital of an annual State appropriation of $45,000.

I will pass over the routine social service work which is done in every hospital such as the investigation, help, and placing of cases which come into the hospital from day to day, and its action as a means of contact between the hospital and the many charitable and other agencies which exist in every community. This work takes much of the time and is the daily routine of social service, and we accept it now as a matter of course.

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[1] Read at meeting of the American Ophthalmological Society, June, 1920.

As the work developed it became evident that we could not burden the Social Service or Follow-up with every case which was admitted, and more and more we came to divide the material into certain groups.

From the standpoint of follow-up work, I think the most important group is formed by the acute cases, in which sight may be lost speedily unless provision is made for effective and continuous treatment. I refer especially to the severe corneal ulcerations, the acute cases of iritis, and to the injuries of the eye. All these cases should be admitted to the hospital, but there may be no bed or there may be an unwillingness on the part of the patient. Even if a patient refuses to enter, I do not think it is right for us to wash our hands of him and trust to luck that he will return to continue his treatment or will go elsewhere. We do not have this trouble often with the injury cases; but with the others and when they refuse to enter, we register them on our follow-up list and take measures to induce them to return. Such measures are usually successful. At least, we can get them into other medical hands. It is certainly contrary to sound economic policy to abandon them.

From the standpoint of saving sight, one of the most important, if not the most important, group of cases we have to deal with is formed by the non-congestive glaucomas. The congestive glaucoma case will ordinarily return of his own volition. I regret to say that I have seen a not inconsiderable number of hospital cases that have gone practically blind because they have either been ignorant or were discouraged with the apparent lack of benefit from treatment. It comes down to the fact that unless you have the means of reaching patients and getting them back, practically no glaucoma cases should be trusted on miotic treatment, and this works a very considerable hardship on these cases where miotics are indicated. Under our present arrangement, glaucomas are calendared for certain dates and are brought back with certainty.

If on miotic treatment, they are seen frequently and until the doctor in charge is satisfied that they understand the technique of using the drops and are sufficiently impressed with the importance to themselves. They are then put on the regular schedule of visits every three months. We find that once the hospital patient realizes that a personal interest is being taken in his case it is comparatively easy to get him back.

The next group is the tubercular one, and in this I should like to include phlyctenular disease. The class for ocular tuberculosis which was carried on at our hospital for nine years has been described elsewhere and needs no comment, except to say that in my humble opinion it still forms the best method of handling this very resistant and stubborn disease. Unfortunately, our class was interrupted by the war and has not yet been reëstablished, but it will be when funds allow. These patients form a relatively small group and require intensive work, especially in the homes. The phlyctenular group presents a somewhat similar, but less acute, problem. It is not improbable that these cases also might best be treated in classes. This is the material that best illustrates the value of social work. At present, all our phlyctenular cases are automatically referred to the Social Service Department. It is the duty of that Department to follow these cases through. They are given examinations of the nose and throat, teeth, and a general physical as a routine, and the home is investigated. In view of all the information obtained, the future method of handling each case is decided upon. As has been pointed out before, the phlyctenular child often means a case of open tuberculosis in the home, and, as such, is of importance to the community.

The interstitial keratitis group pays the social worker a large dividend. A full time worker is wholly occupied by these cases in our hospital. They are also referred to the Social Service by virtue of the diagnosis and are examined in much the same way as is the phlyctenular group. Once the diagnosis is made, however, their general treatment is carried out in the syphilis clinic of the Massachusetts General Hospital, and finally, when their eyes no longer need attention, they are turned over to this clinic for continued treatment. This group again is of public health importance, and great pains are taken to bring in and to investigate the condition of the parents and other children. A study of some of these cases was presented at the American Medical Association meeting in 1917. At present we have about seventy active cases under treatment.

Another important group is represented by the cases of ophthalmia neonatorum. Without the social worker we should be at a loss in handling them. Many of these babies require breast milk if they are to live. This may often be obtained from the mother or elsewhere, so that it is important to establish contact with the home at once. Perhaps the case shows neglect—it is for the social worker to find where the fault lies, that it may be presented to the proper authorities. In the gonorrheal cases, the disease is present in the mother and often in the father, and they must be brought to the hospital and treated. For the benefit of future babies, they must be told plainly the nature of the disease they suffer from and what its consequences are, and a great deal of valuable work can be done along the line of preparing the home for the return of the baby. All this work should be done by other agencies than ours, but, as yet, the public health authorities have been unwilling to undertake it.

The last group I propose to touch is the myopic one. Prevention is better than cure. We see a not inconsiderable number of cases each year that have become industrially unfit through increasing myopia. We have started to check up our myopes each year, and expect to institute measures of control in those cases where progress is alarmingly rapid.

As a matter of survey, the Department has undertaken to tabulate for a year the industrial accidents which pass through the clinic or are entered directly to the wards from the scene of injury. During the past seven and one half months 154 such cases have been admitted. The findings of the entire year may show something worth while, and the Department hopes to be able to work out the problem in conjunction with the Massachusetts Industrial Accident Board.

More and more, as time goes on, does the work take on a public health phase, and on this account it has been thought best to attach to the Department at least one worker who has an intimate knowledge of the entire workings of health departments and public and private health agencies in the State.

The work is wholly an educational one, which cannot be carried out by the Department alone, but, in its far-reaching aspect, is a coöperative one and can be done only by the close interrelation of outside and inside agencies.

One phase of follow-up has not been touched, which is the routine return of selected cases each year so that the final results of operation and treatment may be learned. This seems to me to be of the greatest importance for every hospital.

This, in brief, covers the principal lines along which we are working at present, and it should be emphasized again that this paper has not touched routine social service work, which must form a very large part of the activity in every hospital.

UVEITIS DEPENDENT UPON FOCAL INFECTION IN THE APPENDIX.[1]

By Dr. HUNTER H. McGUIRE, Winchester, Va.

THE experience of the past ten years in the treatment of inflammatory affections of the uveal tract has proven very conclusively that the septic or toxic origin of uveitis may now be regarded as an established fact. In 1907, Sidney Stephenson (1) asserted that "most probably every case of uveitis is of septic or toxic origin," and de Schweinitz, in a most exhaustive study of chronic uveitis, expressed the same opinion in a paper read before the International Congress of Medicine in 1913. In more recent years, other observers, concurring in the views so fully elaborated by de Schweinitz, have given weight to the evidence submitted by earlier investigators and have reported case histories to substantiate their claims.

The intimate relationship between focal infection and diseases of the uvea has possibly received as much, if not more, consideration in the literature than any other one subject in ophthalmology. Illuminating articles with striking examples of the influence of septic processes in the production of uveitis are frequently appearing in the journals and are stimulating further activity in the study of this very interesting relationship.

To a large extent the literature, to the present time, has concerned itself particularly with those changes in the uveal tissue resulting from focal infection in the teeth, tonsils, nasal accessory sinuses, and to certain auto-intoxications originating from putrefactive processes in the gastro-intestinal tract.

Excluding the syphilitic, tuberculous, and sympathetic types and those due to focal infection in the regions mentioned, little attention has been paid to the influence of septic foci in more remote parts of the body.

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[1] Read at meeting of the American Ophthalmological Society, June, 1920.

The conclusions to be drawn are that either these cases are comparatively rare or that this source of infection is sometimes overlooked.

If, however, we accept the theory of circulating bacteria or their toxins in the blood, if we admit, with Rosenow (2), that bacteria of a focal infection may attain a specific pathogenic and elective tissue affinity, and if it is true, as maintained by Sidney Stephenson and others, that the ciliary body is engaged in the excretion of poisonous substances, is it unreasonable to assume that uveitis may result almost as readily from focal infection in distant organs as from such infections in neighboring structures?

This communication is concerned only with uveitis dependent upon focal infection in the vermiform appendix.

In a somewhat hurried review of the American literature I have been unable to find many references to this source of infection. Indeed, where casual mention has been made of the diseased appendix as an ætiologic factor, the term chronic appendicitis has been usually employed and acute suppurative appendicitis has not, as far as I can learn, been referred to as an exciting cause of inflammatory affections of the uveal tract.

While it is sometimes extremely difficult to draw a sharp distinction between the several types of appendicitis, inasmuch as all are due to bacterial infection, it may be said that the various types are dependent upon differences in degree of the virulence of the infection, and one may, at any time during the progress of the disease, take on the clinical aspects of the other. Thus the chronic type may rapidly pass on to the acute suppurative form and the latter frequently assumes the clinical characteristics of the acute fulminating variety.

As is well known, chronic appendicitis may exist for months or years without causing many symptoms in the region of the appendix and yet manifest itself by a slowly developing toxæmia which may, in turn, cause chronic digestive disturbances or secondary inflammatory changes in other structures. It is, probably, by reason of this fact, therefore, that the few cases of uveitis referred to in the literature as the result of infection in the appendix are said to be attributed to the chronic form of the disease.

As an illustration of its influence may be mentioned the case referred to by de Schweinitz in his article, "The Pathogenesis of Chronic Uveitis," (3) and I take the liberty of quoting the author's account and comment upon this case history:

"Chronic appendicitis, among other abdominal infections, has been made responsible for relapsing uveitis. A case in point is the following: Relapsing iridocyclitis (uveitis) apparently due to chronic appendicitis. Communicated by Dr. B. F. Baer, Jr. A man, age not given, following an attack of acute appendicitis, developed left iridocyclitis, with the gradual formation of total synechia and vitreous opacities. The patient has suffered from frequent attacks of mild appendicitis and with each attack the ocular inflammation has been relighted. In place of iritis, at other times, he has had mild attacks of pleurisy and inflammation of various joints. These have alternated apparently with the ocular inflammation. Negative t. b. tests; Wassermann not applied, but no family or personal history justifies the suspicion of syphilis. Excellent results have always followed strict regulation of the diet, calomel catharsis, and the use of salts.

"The interesting point in this case is that apparently the infection sometimes attacks the uveal tract, sometimes the pleura, and sometimes the serous membranes of the joints, and it would seem to be a good instance of the possibility of a focus of distant infection being the ætiologic factor in uveitis. Unfortunately, there is no account of the condition of the teeth or tonsils."

J. E. Reeder (4), in 1917, reported the case history of a woman, aged 28, who developed a double iritis and who gave a history of having had several attacks of appendicitis extending over a period of eighteen months. The iritis was at first attributed to an infected tooth, the extraction of which failed to arrest the progress of the disease. There was no specific history and apparently no reason for subjecting the patient to the Wassermann test. Under rest, free elimination, sodium salicylate, and the usual local measures, the inflammation gradually subsided. In the course of a month a fresh attack of iritis developed and coincident with this the patient had an acute attack of appendicitis. Operation was advised and an appendectomy promptly done. At the end of ten days the iritis had subsided and two years later no recurrence had been recorded.

The interesting feature of this case lies in the fact that the patient had been subject to what were apparently attacks of chronic appendicitis for a period of eighteen months and not until the condition became acute were there any signs of involvement in the eyes. In other words, a sudden increase in the virulency of the infection in the appendix appears to have been the exciting cause of the ocular lesion.

The case I wish to record presented some rather interesting features and inasmuch as I was able to follow it to its conclusion, I think its problems are worthy of consideration.

The patient, a girl of sixteen, consulted me during the early part of 1918. A week previous to her visit she waked one morning to find the vision of the right eye very much impaired and at once consulted her family physician. A tentative diagnosis of iritis was made and atropine with hot compresses prescribed. As the condition grew rapidly worse she was referred to me. The eye showed marked ciliary congestion, pupil semi-dilated, numerous deposits in Descemet's membrane, and a densely infiltrated vitreous. On account of the density of the media no view of the eyeground was obtainable. The iris, partially under the influence of atropine, showed distinct evidences of involvement. The tension was high and vision reduced to light perception. The whole picture was typically characteristic of those very acute types of uveitis we sometimes encounter.

The general and personal history of the patient, at the time of her first visit, gave no clue whatever as to the origin of the inflammatory condition of the eye. Her physical build and general characteristics were rather suggestive of the tuberculous type, though there was no history to indicate that such was the case.

In the hope of locating the source of the infection she was subjected to the usual diagnostic tests. The Wassermann and the tuberculin reactions were negative, X-ray pictures of the sinuses and teeth showed no signs of involvement, the tonsils and thyroid glands were normal, and the urinary secretions and stools were unaffected. There were no physical signs of pelvic disease and no history of menstrual irregularity.

The eye continued to grow worse despite the fact that both the usual local and constitutional measures were continued over an extended period.

After two months of entirely ineffectual treatment, the patient, on the occasion of one of her visits, for the first time gave me the very interesting information that on the night her vision became impaired she had suffered from rather a sharp attack of pain in the right iliac region. She further stated that during the two months the eye had been under observation, she had experienced several attacks of pain in the right side of the abdomen. Her description of these attacks indicated that they were comparatively mild and of short duration. In fact the pain had not been sufficient to need an opiate or to call a doctor, and under the influence of rest in bed and elimination, promptly subsided.

Because of this history and in view of the fact that other sources of infection had been eliminated, it was deemed advisable to consider the appendix as a possible factor in the case and the patient was again subjected to a thorough physical examination. A diagnosis of chronic appendicitis was made and operation urged. After much persuasion on the part of her physician and myself she reluctantly consented to an appendectomy. The hospital record of the operation recited that the appendix was filled with pus and was almost ready to perforate. Unfortunately the importance of making a culture in this case was overlooked and the type of the infection was, therefore, not recorded.

The patient was seen by me a few days after operation and volunteered the information that there had already been a marked improvement in her vision. From this time on careful observations were made every few days and each examination gave evidence that the inflammatory process was rapidly subsiding. In six weeks the vision was normal and all evidences of inflammation had disappeared.

I had an opportunity to examine this patient eighteen months after operation and during that period there had been no recurrence of the ocular inflammation and the eyeground was entirely free from secondary changes.

The point which this case seems to emphasize above all others, is the importance not only of a thorough and painstaking physical examination in all cases of uveal tract disease, but the absolute necessity of obtaining from the patient such facts regarding the general and personal history as will enable us to comprehensively study the case and make logical deductions as to their influence.

If, in this case, I had been able to elicit from the patient the very definite history of trouble in the right iliac region, which developed coincidently with the ocular inflammation, at an earlier period, the problem would have been simplified and the patient's life and vision would not have been jeopardized. I think it behooves us, as ophthalmologists, to adopt the same methodical and exhaustive methods in taking our case histories as are being practiced by our friends in internal medicine, and I am glad to note that emphasis is being laid upon this point by many of our most distinguished teachers. As Duane (5) very tersely puts it, "The student should be taught to make an examination that is absolutely systematic, thorough, and complete, so that whatever else may be his deficiencies, he shall not miss any diagnostic point from failure to look for it, or miss any symptom from failure to ask about it."

REFERENCES.

1. SIDNEY STEPHENSON. *The Ophthalmoscope*, v., 1907, p. 572.
2. BILLINGS. *Focal Infection.*
3. DE SCHWEINITZ. "The Pathogenesis of Chronic Uveitis," *Internat. Cong. Med.*, 1913.
4. REEDER, J. E. *Jour. Iowa State Medical Society*, Aug., 1917.
5. DUANE. ARCHIVES OF OPHTHALMOLOGY, xlix., p. 19.

RESULTS OBTAINED WITH MÜLLER'S RESECTION OF THE SCLERA IN DETACHMENT OF THE RETINA DUE TO HIGH MYOPIA.[1]

By Dr. E. TÖRÖK, New York.

THE cause as well as the treatment of detachment of the retina in high myopia has long been the subject of lively discussion in medical literature. It must be admitted, however, that both cause and treatment are still unknown, although various more or less acceptable and logical theories have been advanced on this subject from time to time.

The theory which appealed to me most, from the standpoint of cause as well as cure, is the one advanced by Müller in 1903. Müller explained the detachment of high myopia by the enlargement of the globe, a fact which is well known and can be positively ascertained by actual measurements of the eyeball. He says that the enlarged globe causes a stretching of the choroid, thereby interfering with the circulation of the blood therein. This interference with the blood circulation causes the atrophic changes in the choroid and if it increases beyond a certain point a transudate forms between the choroid and the sclera, and also between the choroid and the retina, producing a detachment. According to this theory, therefore, a detachment of the retina is always associated with a detachment of the choroid, the latter always being of a much less degree than the former, because there is a more or less firm attachment of the choroid to the sclera while there is no attachment between the retina and the choroid.

The presence of a yellowish fluid in the suprachoroidal space can easily be demonstrated in every case of detachment of the retina. When performing a Müller's resection at the moment the sclera is penetrated this fluid can be seen to ooze out through the opening.

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[1] Read at meeting of the American Ophthalmological Society, June, 1920.

This theory would explain not only the presence of a detachment, but also the various other atrophic changes in the fundus of a high myope.

If we accept this theory it is logical that the only remedy for these cases is the relieving of the tension of the choroid, thereby improving its blood circulation. Müller attempted this by actually decreasing the size of the eyeball in excising a piece of the sclera.

I performed this operation the first time in 1912 and had the pleasure of reporting about some of these cases before this Society in May, 1917, up to which time I had performed the operation on eleven eyes. Since then ten more eyes have been operated upon by this method, so that the total number, at present, amounts to twenty-one cases.

As I stated in my paper of 1917, the first six cases must be excluded as they were failures on account of lack of technic, therefore it would be unfair to the history of the operation to draw any conclusions as to the merit of the procedure while including these. The short history of the remaining fifteen cases is as follows:

L. M. Woman, 45 years of age, who lost one eye from detachment of retina due to high myopia, came to the Knapp Memorial Eye Hospital in July, 1914, with high myopia and detachment of one month's standing in the other eye. Right eye: No perception of light. Left eye: $\frac{6}{200}$. Right eye diverging. Cataract. Left eye, large detachment below and temporally and extensive myopic changes in fundus.

July 14, 1914, Müller's resection left eye.

On discharge from the hospital two weeks after the operation, no detachment present. Vision: With −8.00 D. Sph. $\frac{20}{200}$.

April, 1917, shallow detachment below, which interferes but very little with her field of vision and sight. Vision: With −8.00 D. Sph. $\frac{20}{200}$.

H. G. Male, 47 years old, right eye lost from detachment of the retina in 1909. Left eye, detachment of the retina with extensive atrophic changes in the fundus; the detachment of five months' standing. Vision: Right eye $\frac{2}{200}$ eccentrically. Left eye: Hand motion.

October 27, 1914, Müller's resection left eye.

At discharge from the hospital there was a shallow detachment below in the extreme periphery. Vision: With glasses $\frac{20}{100}$.

January, 1915, detachment below. Vision: $\frac{10}{200}$.

April 20, 1920, same condition. Vision: $\frac{10}{200}$. Patient is walking about in the street unescorted. He came to me complaining that he was not admitted to the workshop for the blind on account of his vision and wanted to know whether or not further improvement could be had in the vision of his left eye.

Since there was a detachment in the lower portion of the eyeball on April 30, 1920, a Müller's resection was done below behind the insertion of the inferior rectus muscle. The result of this operation was a considerable improvement in the size of field of vision; however, there is still a shallow detachment present below. Vision: Remained $\frac{10}{200}$.

S. G. Male, 32 years of age. Came to the hospital on April 21, 1915, with detachment of four days' standing in his right eye. Vision: Right eye: Hand movement; left eye: $\frac{20}{200}$ with his glasses. Right eye large detachment above extending downward to almost the disk and the retina is also detached temporally and nasally. In the left eye extensive myopic changes including macula.

May 13, 1915, Müller's resection of the sclera.

On discharge from the hospital no detachment in the right eye. Vision: $\frac{20}{200}$ with glasses.

July 30, 1915, slight detachment below in the periphery. Vision: $\frac{10}{200}$.

A. D. Came under my observation in 1911 with high myopia, −24 D. in the right eye and −25 D. in the left eye.

In December, 1911, the right lens was removed and with glasses $\frac{20}{50}$ vision was obtained.

In January, 1914, the left lens was removed and the vision with glasses was $\frac{20}{30}$.

She returned to me in November, 1915, at which time she had a large detachment in the left eye, the vision being only hand motion.

December, 1915, Müller's resection of the sclera left eye.

On discharge from the hospital there was a shallow detachment below and vision was $\frac{15}{200}$.

She returned again in October, 1917, with a detachment in the right eye. Vision: Hand motion. Müller's resection was advised for this eye also, but she could not have the operation performed on account of expecting a baby at that time, and she did not return for the operation until March, 1919, when a Müller's resection was performed on her right eye. Vision: On discharge from the hospital the sight of the right eye was only $\frac{2}{200}$ eccentrically. The fundus was not visible on account of a thick secondary cataract.

April 25, 1920, the condition of her eyes was as follows: Right: Divergent strabismus with a thick secondary cataract. Fundus not visible. Vision: $\frac{2}{200}$ eccentrically. Left eye: Detachment below. Vision: $\frac{15}{200}$. The detachment does not interfere with her daily routine work; attending to her household duties and taking care of her two children.

J. H. Male, 38 years of age. Came to me in February, 1917, with a detachment in his right eye of eight months' standing. Vision: $\frac{8}{200}$. Detachment is shallow, but extends over the entire fundus not including macula. There were also floating opacities in the vitreous. Left eye, high myopic astigmatism with fundus changes.

March 1, 1917, Müller's resection of the sclera right eye.

On discharge from the hospital there was no detachment and vision with glasses was $\frac{20}{100}$.

April 23, 1920, right eye posterior cortical cataract, opacities in vitreous and shallow detachment below and temporally. Vision: $\frac{15}{200}$.

A. F. Female, 38 years of age. Right eye high myopia with slight fundus changes. Vision: With glasses $\frac{20}{50}$. Left eye: Detachment of eight months' standing. The detachment is total including the macula. Vision: Hand movement eccentrically.

February 20, 1917, Müller's resection of the sclera left eye.

On discharge no detachment in the periphery, but a cystic detachment of the macula. Vision: $\frac{10}{200}$ eccentrically.

May, 1917, vision: $\frac{10}{200}$, small circumscribed detachments in the periphery.

April 26, 1920, vision: $\frac{5}{200}$ eccentrically. Macular detachment and also several small detachments in the periphery.

R. G. Woman, 21 years of age, came to the hospital on August 22, 1917, with a detachment of the retina of five months' standing, below and temporally, and also floating opacities in the vitreous. The left eye was normal, emmetropic. Vision: Right eye: Movement of hand. Left eye: $\frac{20}{20}$.

November 14, 1917, Müller's resection of the sclera right eye.

On discharge from the hospital shallow detachment below and at the macula. Vision: $\frac{8}{200}$ eccentrically.

June 4, 1918, vision: $\frac{8}{200}$ eccentrically, shallow detachment below and also detachment at the macula.

H. S. Male, 28 years of age, high myopia both eyes. Left eye, total detachment for five months. Right eye, extensive myopic changes. Vision: Right eye: $\frac{20}{100}$ with glasses. Left eye: Movement of hand eccentrically.

February 6, 1917, Müller's resection of the sclera left eye. Immediately after operation no detachment of the retina. Vision: $\frac{10}{200}$.

July, 1917, no detachment in the periphery, but macular detachment. Vision: $\frac{10}{200}$ eccentrically.

J. P. Male, 35 years of age. First seen March 20, 1918, at which time he complained of failing vision in the right eye for four weeks and in the left eye for ten weeks. Both eyes showed extensive myopic changes in the fundus, floating opacities of the vitreous, and shallow detachment below and temporally. The vision in the right as well as the left eye was $\frac{5}{200}$ with his glasses.

March 27, 1918, Müller's resection of the sclera right eye.

On discharge from the hospital, no detachment. Vision: With glasses $\frac{20}{200}$.

April 25, 1918, Müller's resection of the sclera left eye.

On discharge from the hospital, no detachment. Vision: $\frac{20}{200}$.

June, 1918, both eyes shallow detachment below. Vision: With glasses right $\frac{20}{200}$, and left $\frac{20}{200}$.

I. C. Male, 40 years of age. In June, 1918, noticed that sight of left eye suddenly became very bad. Right eye: Extensive myopic changes. Vision: With glasses $\frac{20}{200}$. Left eye: Extensive myopic changes in the fundus, with detachment of the retina below and nasally including the macula. Vision: Hand motion.

October 18, 1918, Müller's resection of the sclera left eye.

On discharge from the hospital shallow detachment below and detachment at the macular region. Vision: $\frac{5}{200}$ eccentrically.

April 23, 1920, shallow detachment below and central detachment. Vision: $\frac{5}{200}$ eccentrically.

W. M. Male, 40 years of age. First seen April 22, 1919, at which time right eye showed almost total detachment; left eye extensive choroidal changes. Vision: Right eye: Hand motion. Left eye: $\frac{20}{200}$, with glasses.

April 22, 1919, Müller's resection of the sclera right eye.

On discharge from the hospital shallow detachment below and central detachment. Vision: $\frac{4}{200}$ eccentrically.

April 23, 1920, shallow detachment below and detachment at the macula. Vision: $\frac{4}{200}$ eccentrically.

B. K. Female, 24 years of age. First seen October 4, 1919. Left eye lost from detachment of retina ten years previous, eye diverging, lens opaque. Detachment of the retina in right eye for three weeks. The eye showed a large almost total detachment; the macula not being affected. Vision: Right $\frac{3}{200}$; Left: No perception of light.

October 5 and October 11, 1919, posterior sclerotomy right eye with no result.

October 18, 1919, Müller's resection of the sclera right eye.

On discharge from the hospital shallow detachment below. Vision: $\frac{5}{200}$.

April 23, 1920, small circumscribed detachment at various places in the fundus, but macula was clear. Vision: $\frac{10}{200}$. Patient getting along splendidly, able to walk about in the streets unassisted and can do her household duties well.

B. S. First seen January 5, 1920, when right eye showed high myopia with extensive myopic changes in the fundus. Vision: With glasses $\frac{20}{70}$. Left eye: High myopia and large detachment of retina of four months' duration below; the macula was not affected. Vision: $\frac{8}{200}$.

January 7, 1920, Müller's resection of the sclera left eye.

On discharge from the hospital shallow detachment below. Vision: With glasses $\frac{20}{200}$.

May 3, 1920, shallow detachment below. Vision: With glasses $\frac{20}{200}$.

The operation was performed in all these cases as described in my former paper on this subject.[1] The patients were under observation from three months to five and one half years. The detachment was present in the various cases from a few days to two years. In no case did I obtain a permanent total reattachment as reported by others, but I found that all cases showed a great deal of improvement immediately after the operation, at which time the fundus in the greater number of cases showed no detachment. A month or two afterwards a certain amount of detachment usually returned. This detachment as a rule was small and shallow and was situated in the extreme periphery in the lower portion of the eyeball, affecting the patient's sight but very little. This detachment was usually stationary, no advance, or very little, having been observed in my cases, so that it may be said that the vision the patient had about two or three months after the operation was more or less permanent. The return of a certain amount of detachment may be due to the fact that after the operation was performed it probably took some time for the circulation in the choroid to reëstablish itself after the tension upon the blood vessels had been relieved. This may account for the return of some of the detachment. However, after the circulation had been reëstablished the detachment did not advance any further.

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[1] ARCHIVES OF OPHTHALMOLOGY, Vol. xlvi., No. 5, 1917.

The best results have been obtained in cases where the operation was performed within a few weeks after the development of the detachment. In these cases when the choroid is punctured and the fluid is evacuated the immediate result is usually a complete reattachment and later a shallow detachment develops below in the extreme periphery.

Cases where the detachment is several months old are less favorable. It seems to me that in these cases certain parts of the detached retina become walled off, so that no complete reattachment can be obtained even immediately after the operation. Usually several small cystic detachments can be seen in various parts of the fundus, which are more or less stationary.

Cases of total detachment where the macular region is also involved are most unfavorable. I found in all of my cases that the macular detachment remains as a rather circumscribed cystic detachment, causing, of course, a central scotoma, so that in these cases only eccentric vision can be expected.

It is, therefore, my opinion that in cases of detachment of the retina Müller's resection should be performed as soon as possible after the diagnosis has been made. This operation should not be the last resorted to, but the first step in our treatment as it is void of all danger and if performed early promises better results than any other method hitherto practiced. Later, if it is found necessary, it can be followed by any other surgical or medical procedure.

The only disadvantage it has is that it is highly technical, but by no means as formidable or difficult as it appears when one reads a description of it. This impression of extreme difficulty and danger to the eye is, I believe, the reason why this really valuable operation has not become more popular with the medical profession.

There is no doubt that it is necessary to have some practice and experience before the operation can be mastered to such an extent as to obtain satisfactory results, but I believe I can safely state that anybody who can perform a cyclodialysis without puncturing the choroid will be able to master this operation after having performed it a few times. It is not such a large or dangerous operation as it appears.

The preliminary Krönlein resection as advised by Müller is absolutely superfluous as a large external canthotomy gives us plenty of space in which to work.

In my last case, performed a few weeks ago, but not included in the cases noted above, as an experiment I placed the scleral flap to be excised behind the insertion of the inferior rectus muscle and found that the operation can be performed there without the slightest difficulty. After dividing the inferior rectus muscle, with the aid of a strong suture placed in the sclera at the insertion of the muscle, the eyeball can be rotated upwards sufficiently to give space to perform the operation.

The procedure is absolutely void of any danger as far as the eye is concerned. Loss of vitreous cannot occur as the vitreous chamber is not opened, the scleral wound cannot gape, as the scleral flap is not really excised but is pushed between choroid and sclera so that even if the sutures should slip the wound will not open. The eyes always recover quickly and the reaction following the operation is very slight. I usually find a slight œdema and congestion of the bulbar conjunctiva at the site of the operation which disappears in about three or four days.

Just a few words as far as the visual results are concerned. Success in a case of detachment of the retina, of course, cannot be estimated by the vision obtained in the eye. All these cases show the degenerative changes of high myopia with posterior staphyloma, peripapillar atrophy, macular changes, and floating opacities in the vitreous. They consequently are eyes which even before they became blind from detachment have had very poor vision, amounting at best to not more than $\frac{20}{200}$ or $\frac{20}{100}$ and usually to less. If this vision, or even a fraction of it, enough for the patient to walk about unassisted, can be saved, in a condition which otherwise in almost all cases ends in complete blindness, we may be well satisfied.

ILLUSTRATING DR. REESE'S ARTICLE ON "SUCCESSFUL REMOVAL OF THE ORBITAL PORTION OF THE OPTIC NERVE FOR A PRIMARY INTRADURAL TUMOR, WITH PRESERVATION OF THE EYEBALL AND MOTILITY, BY THE KRÖNLEIN METHOD."

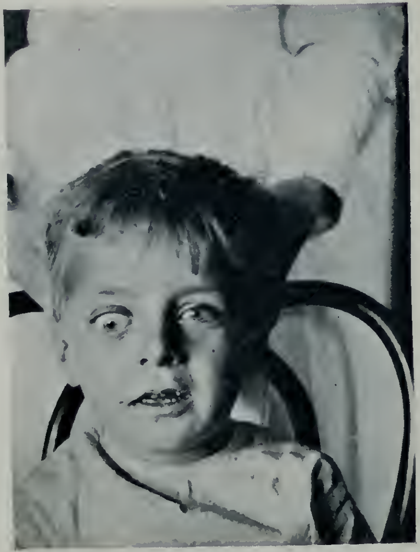

FIG. 1.
Before operation.

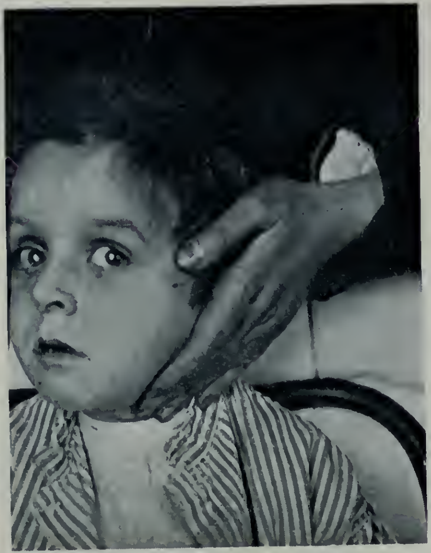

FIG. 2.
Showing motility inward 2 months after operation.

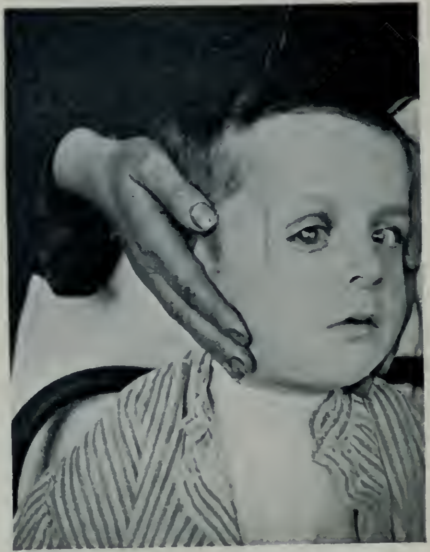

FIG. 3.
Showing motility outward 2 months after operation.

SUCCESSFUL REMOVAL OF THE ORBITAL PORTION OF THE OPTIC NERVE FOR A PRIMARY INTRADURAL TUMOR, WITH PRESERVATION OF THE EYEBALL AND MOTILITY, BY THE KRÖNLEIN METHOD.[1]

By Dr. ROBERT G. REESE, New York, N. Y.

(*With six illustrations on Text-Plates XVI. and XVII.*)

Peter F., aged five, was brought to the New York Eye and Ear Infirmary in October, 1919, because of a prominence of the right eye, which had existed for two years, and followed an injury to the right side of the head. For the past five months the exophthalmos had increased rapidly.

On examination the right eye is pushed forward and downward, the motility of the eyeball is normal outward and downward, limited inward and absent upward, palpation reveals no tumor in the orbit. Hertel's exophthalmometer registered 25*mm* O. D. and 19*mm* O. S. Vision could not be tested.

The right pupil is mid-wide dilated and reacts sluggishly to light. The consensual reflex to each eye is transmitted.

The media are clear; the retinal arteries are attenuated, and the veins distended and tortuous. The disk shows a neuritic atrophy.

Examination of the nose is negative and the tonsils are hypertrophied.

There was no bruit nor pulsation, and an X-ray examination was unsatisfactory. The Wassermann and Noguchi tests were negative; the blood count was normal and hæmoglobin 90. The diagnosis of tumor of the optic nerve is made, and operation advised.

Operation, November 12, 1919.—Under ether the usual incision in the Krönlein operation along the outer margin of the orbit is made. The bone-flap is formed with a handsaw and chisel, and reflected. A horizontal incision is made in the orbital periosteum, and the finger introduced encounters an enlarged optic nerve extending the entire length of the orbital portion.

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[1] Read at meeting of the American Ophthalmological Society, June, 1920.

An aneurysm needle armed with a suture is passed around the nerve and tumor, near the sclera, and the suture securely tied. The mass is then cut through close to the sclera, and traction on the suture draws the nerve outward between the external and inferior rectus muscles. With curved scissors it is excised at the optic foramen. There is little hemorrhage. The flap is replaced and the periosteum is sutured with catgut, and the skin incision is united with silk. At the close of the operation there was no exophthalmos, but the lids were sutured together as a precautionary measure. No drainage was used. The recovery was uneventful.

The tenth day after the operation the sutured lids were opened. The cornea was anæsthetic, and at its center there was a slight cloudiness and a depression in the epithelium with some exfoliation. The cloudiness did not extend more than 3*mm* from the center, and this area gradually cicatrized without the formation of an ulcer. The treatment consisted in the application of a bandage, borated vaseline, atropine, holocaine and dionin locally and iron, quinine, and strychnine internally.

It seems as if the neuroparalytic keratitis was due to a disturbance of nutrition produced by paralysis of a branch of the trigeminus, and not to desiccation.

June 1, 1920, nearly seven months since the operation, the right eye showed an anæsthetic cornea and a cicatrix 2 x 3*mm* just below and external to the pupillary area. The transverse diameter of the cornea was 11*mm*, the iris was lighter blue than the fellow eye, the pupil measured 6*mm* and naturally was irresponsive to light directly and consensually. Hertel's exophthalmometer registered 19*mm* at 110 for each eye. The fundus picture could not be studied from day to day but at the final examination the retinal vessels seem to be pervious, somewhat attenuated but did not pulsate on pressure, and none were transformed to white lines. The disk showed neuritic atrophy, and in the macular region there was marked chorioretinal atrophy with pigmentation. The pigmentation and atrophies which were observed are presumably evidences of disordered circulation.

The position of the eye was normal and the motility in all directions was good.

The pathologic examination made by Dr. James Ewing was as follows:

Gross Description.—The tumor measures 25*mm* in

Illustrating Dr. Reese's Article on "Successful Removal of the Orbital Portion of the Optic Nerve for a Primary Intradural Tumor, with Preservation of the Eyeball and Motility, by the Krönlein Method."

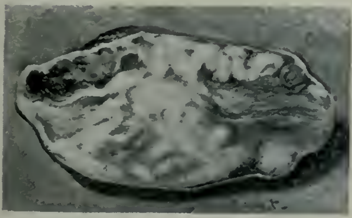

Fig. 4.
Drawing of the longitudinally bisected gross specimen.

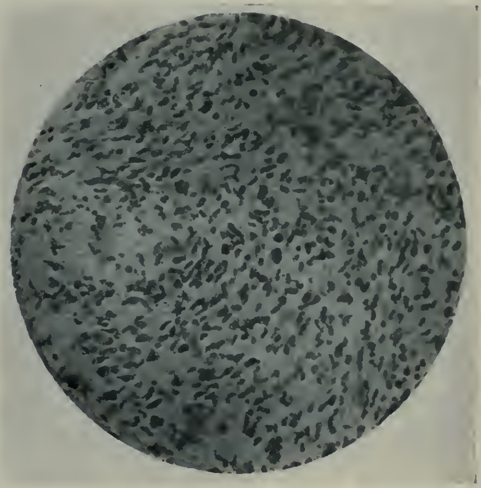

Fig. 5.
High power magnification showing general structure of tumor.

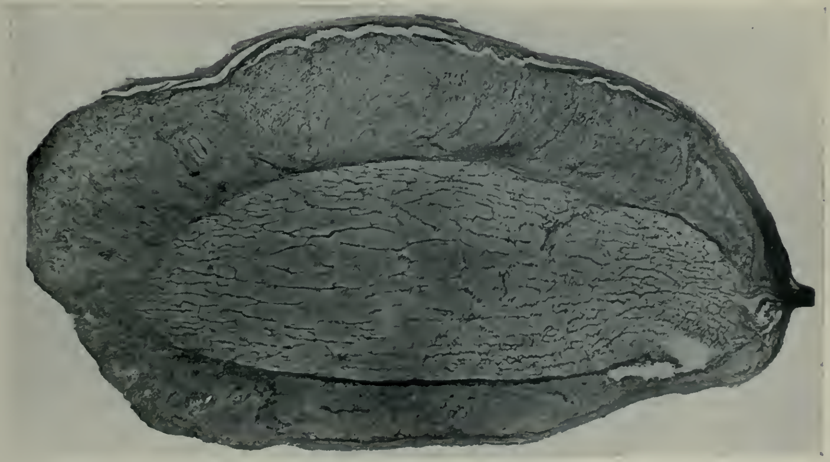

Fig. 6.
Low magnification of whole tumor, showing ensheathing of nerve trunk by tumor tissue.

length by 13*mm* in diameter. It is of elongated oval form, translucent smooth texture, soft consistence, and grayish color. It is sharply encapsulated.

Through the center of the tumor can be seen the outline of the somewhat thickened optic nerve, which is surrounded by the main mass of tumor tissue. This relation suggests that the tumor tissue is derived originally from the structures just within the capsule.

Microscopic Structure: The tumor is composed of compact masses of small cells of indistinct spindle and polyhedral form and containing small slightly vesicular nuclei. There is little stroma between these cells and little of the mucous material so commonly seen in these tumors.

The remnants of the optic nerve are extremely cellular, and in places the overcellular nerve tissue appears to merge insensibly into the tumor tissue. Near the eyeball the bundles of the nerve fibrils are partly preserved, but very cellular, behind there is greater cell overgrowth and the structure in the nerve trunk resembles that of the surrounding tumor.

The capsule of the tumor is composed of dense fibrous tissue like that of the normal dural sheath.

The blood vessels of the nerve trunk area are small, numerous, and pervious, those of the surrounding tumor are very scanty. Anteriorly there is a cross section of a rather large pervious artery.

Interpretation.—The tumor presents the essential features of a primary growth of the optic nerve structures, which may best be designated as myxoglioma. The myxomatous element is, however, not marked in this case. The partial preservation of the nerve trunk with abundant growth of a peripheral neoplasm suggests that the tumor may have arisen from some cells beneath the capsule and not from nerve elements. Yet the whole nerve shows definite and most of it shows extreme overgrowth of cells which must be derived from some cell in the original nerve tissue. The supporting glia cells seem to be the most probable point of origin. It appears likely that the tumor process began behind and gradually advanced forward, thus accounting for the ensheathing of the nerve trunk and its partial preservation near the eyeball.

Intradural tumors of the optic nerve were first described by Wishart (1883) and Byers (1), Parsons (2), Hudson (3), and others have made exhaustive studies of the literature and reported cases. The condition is essentially one of early life; it is indeed probably congenital, and only four cases of Byers's group occurred after the twenty-fifth year. Parsons thinks that nearly all the intradural tumors are a form of fibrous growth, which he called "fibromatosis," even though they were reported under such titles as myxomata, gliomyxomata, sarcomata, and myxosarcomata. All are essentially mesoblastic in origin and are compared with elephantiasis of the subcutaneous tissue. The same author has collected accounts of 18 primary tumors originating within the nerve sheath (extraneural or intradural), as opposed to 102 instances developing in the nerve substance (intraneural).

Hudson draws attention to the fact that fifty of these optic nerve tumors are incompletely removed, and says the Krönlein operation is not essential. In my case the Krönlein osteoplastic resection of the outer bony wall of the orbit, proved perfectly satisfactory, and Knapp's (4) case, with a beautiful cosmetic result, seems to make this operative procedure the one of choice, and would certainly reduce the percentage of incomplete removal. I have witnessed two operations for the extirpation of intradural tumors of the optic nerve where the Krönlein method was not employed and in neither case was the entire orbital portion of the optic nerve removed, and the traumatism was necessarily great.

There is no recorded case of local recurrence in the orbit in spite of the fact that so many of these tumors have been incompletely removed, but it stands to reason that intracranial extension is less likely to occur if the nerve is cut through close to the optic foramen.

Schlodtmann (5) shows that the changes in the ophthalmoscopic picture of the retinal circulation depends upon whether a collateral circulation has been established or not. In the case here reported there did not seem to be any marked difference in the retinal circulation before and after the operation and yet the central retinal artery was shown to be pervious by the microscopic examination, so that the collateral circulation was post-operative and some of the posterior ciliary blood-vessels must have escaped obliteration. The tumors are generally regarded as almost benign, but Byers justly warns against this assumption, as it may be years before the intracranial extension shows itself.

De Schweinitz (6) cites a case where radium did not prove to be effectual on the development of a recurrent growth, but it would be advisable to institute systematic treatment with the X-ray for recurrences as it seems to have a distinct effect on the growth of gliomatous tissue (7).

[The microphotographs were made at the Pathologic Laboratory of Cornell University Medical College by Mr. W. S. Dunn and the drawing of the bisected macroscopic specimen by Miss M. Freret, artist to the New York Eye and Ear Infirmary.]

REFERENCES.

1. BYERS. *Royal Victoria Hospital*, 1901, Montreal.
2. PARSONS. *Pathology of the Eye*, 1905, vol. ii.
3. HUDSON. *Ophthalmic Hospital Reports*, 1910, vol. xviii.
4. KNAPP. *Transactions of the American Oph. Society*, 1915.
5. SCHLODTMANN. *Vossius Sammlung Zwangloser Abhandlungen.*
6. DE SCHWEINITZ. *Trans. Am. Oph. Soc.*, 1915, vol. xiv., Part I.
7. AXENFELD. *Klin. Monats. f. Augenheilk.*, 1915, No. 1.

A CASE OF CAVERNOUS LYMPHANGIOMA OF THE ORBIT.

By Dr. HARRY S. GRADLE, Chicago.

THE following case is presented without discussion merely because of its rarity:

Ethel J., age 7 years. A healthy well-developed child without physical abnormality. At six months of age a small round growth appeared in the right lower lid. This has been growing slowly ever since and attained its present size somewhat less than one year ago.

The inner two thirds of the right lower lid is bulged forward by a subconjunctival mass that seems to extend posteriorly into the orbit. This portion of the lid is discolored and the covering skin is rather tense. The lacrimal punctum is closed by compression. The outer third of the lid is normal as is the upper lid. The mass lies subconjunctivally and is not moveable and has the consistency of orbital fat. The eyeball is turned upward and outward and protrudes about 2 to 3 millimeters. The motion of the eyeball downward as well as inward is limited so that binocular vision is impossible. The eyeball and the vision are normal. The left eye is normal.

The right lacrimal point was dilated and a No. 1 probe passed with comparative ease. It could be felt between the tumor mass and the nose. An X-ray of the orbit gave no further information. Tentative diagnosis, dermoid of the orbit.

Under general anæsthetic, an incision 3 centimeters long was made through the lower lid parallel to the lid margin. A blueish lobulated multi-locular cystlike mass lay directly under the fascia tarso-orbitalis and was freed with some difficulty by blunt dissection. During the dissection, one cystic portion ruptured and a small amount of dark brown fluid was evacuated, leaving a collapsed and empty cavity.

The mass was completely removed, leaving a funnel-shaped cavity about 5 centimeters deep. Three days later, the eyeball was in nearly normal position and binocular vision was present. Within two weeks, the eye was in normal position, and the only remaining trace was the scar of the linear lid incision.

The tumor was an irregular pyramidal shaped mass, about five centimeters long and the base measuring about two and a half centimeters in diameter. It was somewhat lobulated and of a distinctly blueish hue. Histologically, the tumor proved to be encapsulated in a rather dense fibrous connective tissue which showed a moderate degree of lymphocytic infiltration. Cavernous spaces, lined with a single or at times a double layer of very flattened endothelium whose cells were widely separated, formed the main mass of the tumor. These spaces are filled with coagulated serum throughout which are scattered some poorly stained red blood cells, a few isolated lymphocytes and some peculiar homogenously stained round bodies that are probably coagulated cell débris. Surrounding the cavernous spaces, which are not connected, is a connective tissue stroma, containing a moderate amount of fat. The entire stroma is irregularly infiltrated with lymphocytes, partially scattered and partially clumped into nodules. In some places these nodules are so dense that true lymph follicles, even containing a germinal center, can be differentiated. Innumerable blood vessels of all calibers are present and all have enormously thickened walls. The thickening is principally due to an increase in the size of the intima, although the connective tissue is also increased in amount. There is some lymphocytic infiltration of the vessel walls and surrounding tissue.

Anatomic Diagnosis.—Cavernous lymphangioma of the orbit.

CAPSULOTOMY BY A NEW PROCEDURE.[1]

By Dr. A. E. EWING, St. Louis, Mo.

(*With three illustrations on Text-Plate XVIII.*)

IN 1910 I became interested in devising a method for removing the lens capsule in senile cataract extraction which would be accompanied by the least disturbance to the eye. I had experienced many bad results from the ordinary cystotome and sickle needle capsulotomies, which often required subsequent discission of membranes, not only in my own extractions but in the extractions of my esteemed colleagues, Dr. Green and Dr. Post. It seemed to me that these results might be avoided and that this could be accomplished with less disturbance in the initial operation. My first innovation was with the de Wecker scissors. The blades of this instrument frequently slipped over the capsule, and a toothed scissors was substituted, then a knife forceps with a tooth at the end of each blade, and then another knife model with a sinuous knife edge, as in the ordinary bread knife.

My experience with these several forms of instruments taught me that the texture of lens capsules varied greatly, more than can be determined from careful inspection, and that capsules might be classed as tender, moderately tough, and tough. Tender capsules are usually found in immature cataract, and cataract that is just ripe, sometimes in the over ripe or Morgagnion variety. However, the over-ripe cataract is liable to have a capsule that is more fibrous and which will have a dense tough membrane to be dealt with later. Cataracts which follow corneal ulcers, iritis, choroiditis, and glau-

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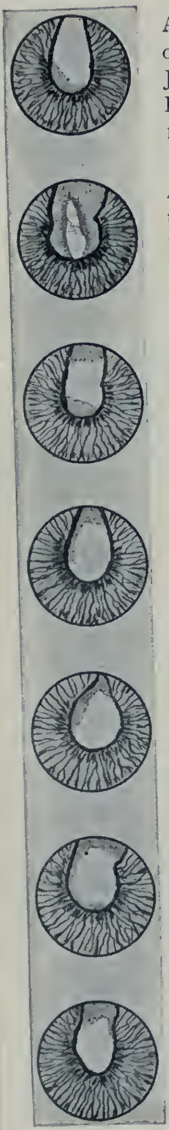
[1] Read at meeting of the American Ophthalmological Society, June, 1920.

Illustrating Dr. Ewing's Article on "Capsulotomy by a New Procedure."



Age 49. Old central nebula of the cornea. Extraction January 19, 1916. V. = 20/38. Reading vision 5 point type. 1920, May 20, V. = 20/38.

Age 55. Old choroiditis. Extraction October 22, 1917. Tough capsule. V. = 20/30. Reading vision 3½ point type.

Age 50. Extraction December 1, 1917. V. = 20/20. Reading vision 3½ point type.

Age 74. Extraction April 4, 1918. V. = 20/30. Reading vision 3½ point type. 1920, June 1, V. = 20/30.

Age 52. Extraction May 25, 1918. V. = 20/20. Reading vision 3½ point type. 1920, May 11, V. = 20/30.

Age 52. Old central nebula of the cornea. Extraction October 8, 1918. V. = 20/38. Reading vision 5 point type. 1920, May 20, V. = 20/38.

Age 68. Extraction November 15, 1919. V. = 20/24. Reading vision 3½ point type.

Fig. 2.

Diagrams which illustrate the character of pupils obtained with the Abscission Capsule Forceps.

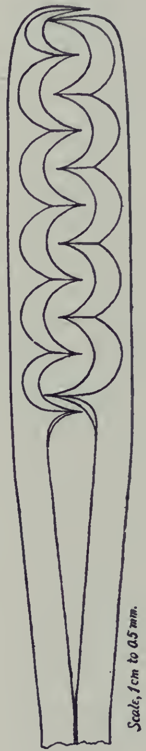
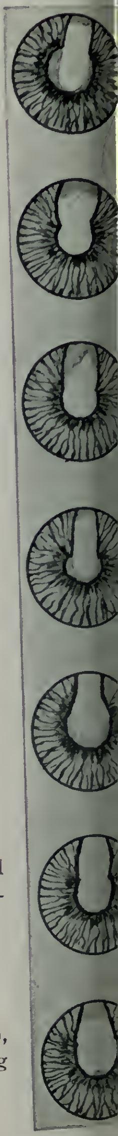


Fig. 1.

Abscission Capsule Forceps. A schematic drawing which shows the construction of the blades.



Age 53. Extraction December 11, 1919. V. = 20/20. Reading vision 3½ point type.

Age 66. Extraction March 23, 1920. V. = 20/20. Reading vision 3½ point type.

Age 53. Extraction April 7, 1920. V. = 20/20. Reading vision 3½ point type.

Age 58. Extraction April 12, 1920. V. = 20/38. Reading vision 3½ point type.

Age 67. Glaucoma. Previous iridectomy. Tough capsule. Extraction April 14, 1920. V. = fingers at one foot.

Age 53. Extraction April 27, 1920. V. = 20/20. Reading vision 3½ point type.

Age 57. Extraction May 29, 1920. V. = 20/30. Reading vision 3½ point type.

Fig. 3.

Diagrams which illustrate the chara of pupils obtained with the Absciss Capsule Forceps.

coma are apt to be accompanied by tough capsules and not infrequently by tender zonulas. In my trials with scissors I discovered that tender capsules were often slippery and that the scissors blades would glide over their surfaces without making any impression. The forceps with the undulating knife edge not infrequently would act in the same manner. The failure of these instruments to bite into all capsules led to the construction of the instrument the blades of which, greatly enlarged, is illustrated in the accompanying schematic drawing (Fig. 1). The handle may be such as to suit the idea of the operator. The blades differ from those of other capsule forceps in that the teeth are sharp and pointed and the sulci in between the teeth are ground to a knife edge, thus forming a series of cystotomes set at an angle in such a way as to cut as the blades are closed. None of the teeth touch when the blades interlock except the teeth at either end of the blades, the interlocking of these teeth being necessary in order to cut the incised portion of the capsule away from the remainder of the capsule.

The manipulation of this form of forceps is the same as with other forms of capsule forceps with the addition that when in position the blades are opened and closed several times with two purposes in view, the certainty of dividing the capsule the full length of each blade, and the chopping of the soft cortex into fragments. In withdrawing the forceps it should be brought a little forward as the teeth may engage the nucleus and drag it upward in the capsule. In this event the nucleus should be replaced with the spatula. The lens is then expressed in the usual manner, as a rule leaving a clear pupil.

With sickle needles and cystotomes the mechanical action is pressure backward and traction on the zonula from one side to the other. With the majority of capsule forceps the traction is on the capsule from either side and in the withdrawal of the forceps also from below, necessitating traction on the zonula at the sides and below, and from above in the final withdrawal. In this last manipulation there is always danger of the loss of vitreous. With the model here presented these dangers are obviated. The teeth engage the capsule with almost no pressure and the cutting is clean and practically free from traction. It has occurred with me in several instances that the end teeth have hung the capsule, and its lower margin has floated upward in the delivery of the lens. However, in these instances the capsule returned to its position and caused no later trouble. This accident is not likely to happen if the teeth are very sharp.

With the general run of extractions with this instrument as will be seen from the diagrams (Figs. 2 and 3), there is a further special advantage in its action in that the capsule about the upper margin is not broken from the zonula. This is a protection against the loss of vitreous. Possibly there is no advantage in retaining the capsule in its position, but to me, it is a protection against injury to the zonula and the anterior portion of the vitreous. If these injuries can be prevented I believe it means safety to the future of the eye.

Another apparent advantage is the retention of any remaining lens cortex within the capsule. It is pretty well established that lens substance does not make trouble unless it is in contact with the iris. I have seen this demonstrated in several cases in which considerable cortex remained, and was slowly absorbed without giving trouble.

A further advantage is that the several cystotomes chop the cortex into fine fragments in the opening and closing action mentioned above, which causes it to come away more readily as the nucleus is delivered. This has seemed to be of importance because from a number of cases which have been operated on I have acquired the impression that the cortex mainly occupies the anterior portion of the lens. This observation I once mentioned to Dr. Alt and he said that this had been demonstrated by Becker many years ago, but did not give me the reference, and I have not happened to run across it. Shahan has reminded me that in the accommodation the anterior portion of the lens is chiefly in action and has suggested that this may have something to do with the nucleus being nearer the posterior capsule. In the few lens sections of normal eyes of persons about 45 years of age that I have been able to examine, I have found very little difference in the width of the cortex anterior and posterior to the nucleus, but clinically there does seem to be a difference.

For the purpose of illustrating the action of the forceps on the capsule a number of average pupils are shown in the accompanying diagrams (Figs. 2 and 3) together with the age of the patient, the date of operation and the visual results. Since I have been employing these forceps my visual results have been improved, and I have seldom had to resort to a secondary discission.

As with everything in the instrument line that is new and difficult, I have had trouble in getting these forceps made properly. I am indebted to Mr. Hermann Weder of the Weder Manufacturing Company, Philadelphia, for his patience in helping me to perfect the instrument. It should be very sharp and several should be kept on hand to permit of their return to the maker to be resharpened, as in the case of cataract knives.

I wish to add further that these forceps should never be depended on when the pupil is filled with blood, as the iris may become engaged and the result might prove to be disastrous. It is intended for cases in which the margins of the pupil can be easily outlined. In these last cases it has never failed to remove the central portion of the capsule.

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. CONRAD BERENS, Jr., Secretary.

MEETING OF APRIL 15, 1920. DR. A. E. DAVIS, CHAIRMAN.

A meeting of the Section on Ophthalmology was held in conjunction with the meeting of the New York Academy of Medicine on April 15, 1920.

Dr. W. Holland Wilmer of Washington, D. C. (by invitation) read a paper on **The injurious effects on the eyes of the various toxæmias** which appears in this issue of the Archives.

Discussion: Dr. Warfield T. Longcope: The paper of Dr. Wilmer, which we have all listened to with so much interest, emphasizes again the importance of focal infection as the cause of pathological changes at a distance from this focal infection. One may regard the presence of focal infection perhaps from two related points of view. First: from the standpoint of preventive medicine, and second: from the standpoint of therapeutics. It is generally recognized, now, as Dr. Foster has already pointed out, that a large proportion of individuals do suffer from focal infection over a period of weeks, months, or years, sometimes during the course of their lives. And as far as we can determine, only a certain proportion of such individuals show any ill effects from carrying these infections, that can be discovered with our present method of examination. On the other hand, evidences are accumulating to show that there is a direct relationship between focal infections and such conditions as chronic arthritis, endocarditis, or, as Dr. Wilmer has so well pointed out, a variety of pathological changes in the eye. The latent danger, therefore, to patients carrying focal infections, is sufficient indication for removal if possible, of such foci, and thus from the standpoint of general prophylaxis and preventative medicine, there should be a careful search for and removal of local infections, such as those about the teeth, tonsils, sinuses, etc.

It is, on the other hand, very difficult to determine in any given case the exact relationship between focal infections and the systemic diseases, especially since the lesions are not specific either in pathology or ætiology. It is impossible to state definitely that an apical abscess is the cause of chronic arthritis. For this reason, one case of which Dr. Wilmer spoke is of much importance. I refer to the patient who suffered both from focal infection and tuberculosis, and in whom the pathological changes in the eye were found ultimately to be caused, not by this focal infection, but by tuberculosis. This illustrates one of the difficulties encountered in such cases.

Ultimately, no doubt, through the careful and constant study which is being devoted to this problem, methods may be devised by which more accurate diagnosis may be made than is at present possible. For it would be a great advance, if by any means, one could determine definitely the type of focal infection in one portion of the body which was the cause of a local disease in some distant organ.

Dr. NELLIS B. FOSTER said that Dr. Wilmer had touched upon a number of questions that were not only interesting to the ophthalmologist, but equally interesting to the internist. Some of the questions which Dr. Wilmer had been forced to pass over rather cursorily were of very profound significance and, in fact, went to the roots of questions of pathology. This question of focal infection was one that was very much to the front at the present time and was one in which they were all primarily concerned. Dr. Foster then called attention to certain points by way of caution in deductions based on evidence that at first sight seemed quite conclusive. All knew how frequent focal infections were. Beyond a certain period of life it was doubtful if any of us escaped, and so we must postulate a second factor, namely, individual predisposition. since some individuals maintain robust health in spite of these known foci. Dr. Foster said he did not wish to convey the impression that the expression, predisposition, was used in a scientific way at all. His meaning, he said, was best brought out by Dr. Wilmer's remark about antityphoid inoculation in respect to the eye. It did not require any stretch of imagination to think that in certain individuals antityphoid vaccination might give rise to certain demonstrable lesions in the eye. As was known, the great majority of persons inoculated with antityphoid vaccine showed only slight and transitory symptoms, a little fever, malaise, and slight muscular stiffness. But there was a small minority in which quite a definite train of graver symptoms developed. To one of these types he wished to call attention because, so far as he knew, only a few cases had been seen and he himself had seen a number. These were cases that showed a type of reaction that might be called purpuric. The manifestations in these individuals were first, a purpuric rash such as one saw typically in cerebrospinal meningitis. The rash appeared twelve hours after inoculation and was associated with fever and might be associated with hemorrhages. In some cases there were only a few hemorrhagic spots on the skin, along with hemorrhage from the kidneys or intestines and epistasis. If hemorrhage occurred in the skin, kidneys, or intestines, it stood to reason that it might occur in the central nervous system, and he had seen one case in which it did occur causing a transverse myelitis and a number with meningismus. We had here again the same factor to which he had called attention and which must be constantly remembered, namely, that there were exceptional individuals with unusual predispositions. These cases of atypical reaction Dr. Foster said he had seen in the army, and they were all apparently healthy individuals; he had examined them and found no evidence of disease. This brought him to the second point he wished to mention, which was that these hemorrhages in the retina, or elsewhere in the body, were due either to changes in the blood vessels or changes in the blood. We knew at the present time no other cause for hemorrhages, except changes in the endothelium of the arteries, and changes in the blood itself; for example, in infectious diseases there was a proneness to embolism or thrombosis as well as to hemorrhages. These hemorrhages that Dr. Wilmer mentioned as occurring in the eyes of young men could be explained in no other way than that just offered. Cerebral hemorrhages were not at all a rare thing even in children where there could not be demonstrated any such disease as syphilis, which is thought of as the ætiological factor in degeneration of the vascular system. It is thought such hemorrhages were explained by the effect on the blood vessels of past infectious disease, perhaps a trivial disease of childhood. If, as sometimes happened, these cerebral hemorrhages were so severe as to cause death, it seemed not at all an incorrect deduction that they might occur in the small vessels of the eye, because the eye is in fact a projection of the central nervous system. One other point which Dr. Foster discussed was in regard to the treatment of uveitis with thyroid. He said he had had occasion to look into that subject. A good many ophthalmologists seemed to believe that many disturbances of the eye were of endocrine origin, and thyroid extract was recognized as the one mode of approach in the treatment of uveitis. He had been somewhat puzzled over that fact and thought that the supposed benefit of that treatment was due to other causes than that suggested. Uveitis was a disease that progressed in waves, and the period of improvement might conceivably be coincident with the administration of thyroid extract. Another reason might be that small doses of thyroid were stimulating, and brought about the same improvement that might be brought about by a change in climate, stimulating the appetite, increasing body weight and rejuvenating in the larger sense some dormant functions; so that the improvement of uveitis which occurred in individuals who were subnormal in health could be explained on those grounds. While improvement in uveitis might occur under the administration of small doses of thyroid, it was inconceivable that large continued doses of thyroid extract should cure the disease. The assumption of a relationship of some other obscure diseases of the eye to other endocrine disturbances, so called, seemed to him simply a mask for our ignorance. He would like to know what Dr. Wilmer thought about it.

Dr. ROBERT G. REESE, the relationship between toxæmias and diseases of the eye is a complex one, and unfortunately the clinical picture is by no means characteristic. We are apt on account of our wonderful successes, to forget there are other ætiological factors in diseases of the eyes and adnexa.

While it is true that all diseases of the uveal tract are either of septic or toxic origin, the successful elimination of these agents is often perplexing. The history is quoted of a woman 50 years old with bilateral uveitis of eight year's duration. She received tuberculin, subconjunctival injections, and antiluetic treatment. The tonsils and some abscessed teeth were removed. General examination showed Paget's disease, aortitis and colitis. The patient is at present getting streptococcus vaccine, arsenic, and salicylates.

Dr. GEORGE H. BELL: Toxæmia from food intoxication, bad teeth and tonsils, is the most important subject before the medical profession to-day. Last June at the meeting of the A. M. A. I stated that a dirty mouth was one of the greatest menaces of the human race. The late Dr. Osler said recently that bad teeth were causing more ill health and misery in the world than strong drink. From time to time in the last ten years, I have called the attention of the profession to the fact that modern dentistry is producing more disease than any other cause. My first paper on this subject was read here at the Academy of Medicine in October, 1910. What are the causes of toxæmia and what are its effect on the eye? If we exclude syphilis and gonorrhœa, I believe that all the eye conditions that we see, are caused directly or indirectly by focal infections, and the three most potent ones are bad teeth and tonsils and food intoxication, all of which can produce a general toxæmia, which may have a local manifestation in the eye, in the form of uveitis, choroiditis, iritis, episcleritis, optic neuritis, and keratitis. J. Herbert Parsons in 1908 said in his *Pathology of the Eye*, that oral sepsis is an undoubted cause of iridocyclitis, owing to the absorption of toxins into the circulation.

I realize that there are a lot of things we cannot prove in regard to the doctrine of focal infections and toxæmia. But when we see case after case of iritis, choroiditis, and episcleritis get well after removing the foci of infection; then, in the absence of positive proof, the process of elimination is good enough for me.

I believe that an endogenous septic endophthalmitis may occur in any eye any time, whenever there is present in the body a focus of infection from which toxins or bacteria can escape into the circulation. Why the optic nerve should be affected in some cases of toxæmia, the uvea in other cases, the cornea in some and the vitreous in still others, I am not able to state, nor am I able to state how it is brought about. We must all admit, however, that toxæmia may result from chemical changes in the intestinal contents, and that the absorption of bacteria and their toxins does take place, and that the blood stream is the carrier of the infection.

Dr. James G. Dwyer wished to congratulate the speaker on the paper of the evening, and had only wished that more of the statistics of the various types of cases had been brought out. He wished to speak of the various types of infections, and bring out some of the points that had impressed him during the last ten years. From a personal experience of over twenty thousand Wassermann reactions done during the last seven years, and from an investigation of over one hundred and fifty eye cases of so-called focal infections, he wished to say the following:

First: Syphilis. The diagnosis of syphilis of the eye is comparatively easy, as the above experience has shown, that in the vast majority of syphilitic eye cases, the Wassermann reaction is reliable, as the lesion is so situated that a positive reaction is easily obtained.

Second: Tuberculosis. Regarding tuberculosis, the intracutaneous test, in contradistinction to the superficial skin reaction, has proven in the last two years to be thoroughly reliable, as an evidence of active tuberculosis and can be followed by the subcutaneous test, care being taken to carry out this latter test thoroughly.

The big questions arise as to the focal infections from the teeth, tonsils, intestinal tract, and other occasional foci, and this is where we need light.

His experience leads him to believe that the laws of physics relative to a fluid under pressure, was a very important factor. Focal infections were more apt to occur under such conditions, as an apical abscess at the root of a tooth, with the pus in a closed cavity under pressure, than in pyorrhœa, where there was an open infection. The same was true of old fibrous tonsils with pus shut up in closed crypts, or in tonsils that had undergone partial removal, where the mouths of the crytps were closed by scar tissue. The same reasoning applied to the intestinal tract or to the prostate gland, etc.

Following this reasoning a step further, the thought occurred that the whole process, may be one of bacterial anaphylaxis, in contradistinction to serum anaphylaxis, and that this may in the future lead to some scientific data. An immense amount of work on bacterial anaphylaxis has been done and a perusal of the literature may suggest some methods of attacking the problem.

Dr. Walter B. James: Dr. Wilmer's delightful paper presenting this timely subject in so clear a way has done a service to the whole profession of New York, not only to those practising in the field of ophthalmology but to everybody charged with the responsibility for the care of the sick, no matter what part of the body may be at fault. Whatever specialty we may be practising, we have come to realize that focal infections, and indeed the other intoxications, have a far-reaching significance. While the expectation of human life has increased very greatly during recent years, and entirely through the efforts of the medical profession, it is generally admitted that this increase has been brought about by improvement in the mortality rate of infancy and childhood rather than because of any well marked impression made upon the death rate from the diseases of later life.

Dr. Wilmer's paper suggests quite a different point of view towards these later diseases than that which has obtained during the past thirty-five or forty years and before. It has been customary to assume that when a man of middle life has a disease, for instance, of the kidneys or of the heart or of the joints, and when by the use of instruments of precision and careful diagnostic methods we have located the lesion and told him that his symptoms are due to Bright's disease, hardening of the arteries or sclerosis of the heart muscle perhaps, and have made a prognosis telling him how long he has to live, we have been wont to feel that we have done our duty. To-day, fortunately, we are taking less interest in the minutiæ of physical diagnosis and are giving more attention to the study of the ultimate origin of the disease in the individual case.

Physicians used to ask a man of fifty or sixty who was suffering from Bright's disease or other organic trouble what his father died of. When he replied, dropsy at the age of sixty, the physician would say, this is about what you have to expect.

We used to ask a man if he was a hearty eater and if he replied that he was, we ascribed his trouble to eating too much; if he said that he was a very light eater, we perhaps attributed it to too little nourishment. We asked him if he was a hard worker and generally his wife answered that her husband had always worked himself to death, and then we said no wonder you have a chronic disease. As a matter of fact, it is a matter of much doubt whether people do get Bright's disease or heart disease because they work too much or too little, or eat too much or too little, and we are not at all sure now even that alcohol has played as important a part in the causation of diseases of middle life as we had once thought.

Therefore this modern conception of medicine and diagnosis and its purpose as presented by Dr. Wilmer this evening, is intensely interesting and applies to every branch of medicine and to the diseases both of the body and the mind, for even in mental diseases it is becoming more and more clear that the body, and the entire body, should be searched for causes of the malady. There is probably a definite cause for every kind of disease and we should demand to know this cause if it is discoverable by any means at our command, and if we cannot discover it, we should honestly admit that the fault is our own.

One of the great difficulties of course in treating diseases of middle life is that we are apt to find that they are not simple but very complicated. The late Dr. Jacobi, in his delightful way, once told me that he preferred to treat children rather than adults because almost invariably a child has but one disease at a time, whereas adults rarely have only one.

The profession should accept the principle that when an individual manifests any departure from the normal in any function, the making of a diagnosis in the old-fashioned sense is only the beginning; that there is a definite cause for this disturbance and that this cause should be sought by every means that medical science offers.

Dr. Reese in his discussion, regretted that Dr. Wilmer said nothing of his failures. Dr. Wilmer, like the rest of us, is human and of course he has had failures. Like the rest of us he has had at his command only such knowledge of physiology, pathology, and causation as medical science of to-day offers, and while he has pointed out to us that many cases of serious organic diseases of the eye have a remote physical cause in some part of the body, perhaps far distant from the eyes, yet there are doubtless other causes of these same eye lesions which are not accessible to us to-day but which will certainly be accessible to the physician of the future, if the profession continues to take the broad view of medical science that it always has taken. There are perhaps causes other than focal infection and other intoxications, causes that we have not yet dreamed of, but some day they will be known and understood. Future studies and the lapse of years will probably open up new and wonderful vistas for medicine, and with these the ability to either ward off or cure or ameliorate a good many of the diseases of middle and later life which have hitherto proved so obstinate. Of course chronic rheumatism, as well as eye lesions and probably a good deal of vague ill health without definite local complaint, are caused by foci of infection in the teeth and tonsils, but we have all seen plenty of cases of this type where the disease went on just the same after the teeth and tonsils were removed. I have seen a number of cases of very obstinate rheumatism of the rheumatoid arthritis type, in persons who had completely recovered from a pulmonary tuberculosis, usually with some cavity formation and in whom no local cause could be found in the teeth or in the tonsils, and in whom it seemed at least possible that the intoxication came from a healed cavity at the apex of the lung which gave few or no symptoms of the ordinary type.

Then there is the alimentary canal, especially the colon and the iliosacral valve, offering possibilities of ill health from intoxication, but this is a chapter which is always vague and upon which a great deal of work still remains to be done.

Dr. Wilmer's paper is interesting then to those practicing in every field of medicine, pointing out, as it does, defects in the teaching of diagnostic medicine and emphasizing the need of searching more diligently for the cause of disease in each individual case. The medical profession of New York is deeply indebted to Dr. Wilmer for his willingness to come to New York, especially at a time when traveling is no simple matter, in order to lay before it the results of his vast experiences and his own philosophical reflections upon these experiences.

Dr. W. H. WILMER in closing the discussion said: Unfortunately one cannot always report cures; for the fact must be borne in mind that all cases cannot terminate favorably, even where the toxic source has been discovered, on account of the damage already done—as in the case of a central choroiditis or retinitis proliferans.

When the influence of oral sepsis upon the general system was first appreciated there was a tendency to sacrifice teeth recklessly. There is always a tendency for the pendulum to swing just as far the other way. The middle course is generally the right one.

Undoubtedly apical abscesses are far more dangerous as a source of toxæmia than pyorrhea alveolaris. But he is convinced that some ocular lesions occurring in his practice have been due to pyorrhea alveolaris when the process has been extensive and the patient's resisting powers have been lowered.

REPORT OF THE ANNUAL CONGRESS OF THE OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM.

By Mr. H. DICKINSON, London.

The Annual Congress of the Society took place in London on April 29th and 30th and May 1st, under the presidency of Mr. J. B. Story, P.R.C.S.I.

The President's Address.

The President, in his introductory address, said that two questions had aroused much interest in the ophthalmological world during the past twelve months. The first was the establishment of a higher diploma to distinguish the ophthalmological specialist from the practitioner who had no special knowledge and had had no expert training in the subject. The second was the teaching and examination of medical students in ophthalmology before admission to the Medical Register. On both these matters valuable reports had been published by the Council of British Ophthalmologists. It was this second heading which occupied his attention in this address. A certain knowledge, both theoretical and practical, of ophthalmology ought to be possessed by every person admitted to the Register. There were two reasons for this: the vast majority of practitioners were certain to have to diagnose and treat diseases and injuries of the eyes in certain circumstances when the aid of the specialist could not be promptly obtained, if at all. The second reason was, that in many serious constitutional disorders the evidence afforded by ocular conditions was most important, and often they were the symptoms which induced the sufferer to seek medical advice. Interstitial keratitis was often the first evidence of infantile syphilis, even before the classical teeth of Jonathan Hutchinson had erupted. Ocular tuberculosis might be the first manifestation of that disease, and acquired syphilis might make its appearance in the iris or choroid or retina long after the patient had quite forgotten having had the original disease. Ocular signs were important in tabes, disseminated sclerosis, meningitis of all varieties, brain tumors, nephritis, diabetes, and arteriosclerosis among the common maladies. Every qualified person should have some knowledge of glaucoma, and of the effects of atropine in aged eyes.

Last year, the Council of British Ophthalmologists brought the question of ophthalmological teaching before the General Medical Council, recommending that compulsory attendance at an ophthalmic hospital should be required of all students, and that there should be an examination by ophthalmic surgeons. The reply to that was a recommendation for ophthalmic hospital attendance, but a special examination was thought to be unnecessary. The action of the General Medical Council was regarded with astonishment in Ireland, where, for thirty years, every medical student had given three months' compulsory attendance at an ophthalmic hospital, and had to undergo an examination by two or more ophthalmic surgeons, and the results had been most beneficial to the young doctors, and perhaps still more so to their patients. The object was not to turn out half-educated specialists, but to prevent men being let loose on the public who saw no difference between a leucoma corneæ and a cataract, and who mistook obvious iritis for equally obvious conjunctivitis.

It was held by many that the curriculum would be overloaded if ophthalmology was given this position in medical education. The reply, which was unanswerable, was that no such overloading had been caused in Ireland. There should be no specialty of which the registered practitioner should be quite ignorant. An examination, to be of use, must be a practical and clinical test: a paper examination he considered to be quite useless. Mr. Story related some of his examinership experiences, and, in conclusion, said he feared that the pressure of the Society would have but little effect on the

Mandarins of the General Medical Council, but he had great hopes that the weight of the great mass of the profession who were not specialists would succeed in getting these necessary reforms carried out.

Papers.

Mr. C. H. USHER read a paper on **enlarged corneæ in goldfish.** The paper was called forth by the record of a case of enlarged corneæ by Mr. Treacher Collins. In the fish examined the corneæ seemed to be of uniform thickness. Enlargement of the eyeball had been found in a number of different kinds of fish: these died if left alone, but the condition could be cured by careful attention to the water and food. The gas-bubble disease of fish kept in aquaria was attributed to diminution of pressure. The goldfish examined lived in three small ponds connected by short pipes to allow both water and fish to pass from one to the others. The source of the water was a spring which had been condemned years before for drinking purposes, as it was held to be contaminated with sewage. Hofer repeatedly saw opacity and perforation of the cornea in trout which lived in water containing iron. Burge produced corneal opacities and cataract in eyes of goldfish by ultra-violet rays when the fish were living in certain solutions, but failed to get the same results when they were living in tap water which contained very small quantities of those salts. Gaylord found that artificially reared trout confined in tanks one above the other on a single water supply showed an increasing proportion of thyroid hyperplasias from the highest to the lowest tanks in the series. Adding to the tanks pure water, iodine, mercuric chloride, or arsenic retarded or prevented the hyperplasia. Marine and Lenhart found that three chief conditions influenced the thyroid growth in fish: a limited water supply, overcrowding, and overfeeding with a highly artificial and incomplete food.

Mr. TREACHER COLLINS read a paper entitled **megalocornea and microcornea.** In a case he described in 1913 as one of buphthalmos with full vision and without cupping of the disk, it was evident that the enlargement of the cornea could not be attributed to stretching due to increased intraocular tension. This was shown by the absence of any of the signs of glaucoma, such as contraction of the field of vision and cupping of the optic disk, also by the absence of any ruptures in Descemet's membrane, or any want of definition at the sclerocorneal margin. He described a fresh case which he had recently seen in a woman who was the subject of a peculiar form of dwarfism. He attributed the condition of the cornea to some disturbance in the growth-regulating mechanism. He also showed that there was a condition of under growth of cornea met with in otherwise well-formed eyes.

Mr. JOHN ROWAN read a contribution on **non-operative treatment of glaucoma,** his title being "Are not some cases of glaucoma better treated without operation, and, if so, what are the indications?" The great object, he said, was to determine the cause of the increased tension. If the general factors producing it were known, something in the way of prevention might be done. Several cases had been kept under eserin for periods of months, one for two years, keeping back further developments, and in some cases resulting in improvement. If for any reasons, general or otherwise, an operation seemed inadvisable, keeping the patient under eserin and strict observation seemed best, but in the presence of signs of advancing disease, operation should be done. In the majority of cases he advised operation, especially early operation.

Sir ANDERSON CRITCHETT, in the ensuing discussion, described glaucoma as the bugbear of the ophthalmic surgeon. Admittedly operation should be done early, but in some instances, whatever the type of operation, or however skillfully done, there was a disappointing declension of vision. Some had ceased to operate for chronic glaucoma, and he would be very glad to learn what were the indications for operating, and for abstaining from operation, respectively.

Mr. HARRISON BUTLER'S practice was to operate in chronic glaucoma when the tonometer showed the eye tension was raised and there were signs of functional failure.

Dr. G. MACKAY spoke of the tendency to the formation of pigmentary adhesions between iris and pupil, with diminished transparency following the prolonged use of eserin or other miotic.

Dr. RAYNER BATTEN regarded the cupping of the disk as the disease, and the glaucoma as the symptom: the cupping was progressive, whether or not the tension was relieved.

Mr. Richardson Cross said that if central vision was good, and there was great narrowing of the fields, especially towards the fixation point, and there was an absence of inflammatory symptoms, one could safely rely on miotics. No dogmatic statements could be made which were applicable to all cases.

Mr. Treacher Collins agreed that many cases of chronic glaucoma could be kept in check by the continuous use of eserin, but if the symptoms mentioned by Mr. Cross increased, he advised operation. But such factors as the age of the patient and his expectation of life and his blood pressure must be taken into consideration. If the blood pressure were high, that was an additional danger in operating.

Mr. R. R. Cruise thought the number of cases in which the pressure had been overcome by drops must be small in comparison with those in which the results were deplorable. He spoke highly of the value of the tonometer in these cases, not only in estimating the intraocular tension, but for judging of the progress in a given case.

Dr. A. Hugh Thomson said that as the ocular tension might vary from time to time, even at different hours of the same day, alteration in the visual fields was a surer sign of the condition of a case of glaucoma than the tension.

Mr. A. Greene (Norwich) thought it was to the physician one must look for an explanation of the cause of glaucoma: he should be asked to supply a drug which would control the secretion of the ocular glands, especially the ciliary.

Mr. B. Cridland thought most ophthalmic surgeons were not in favor of simple iridectomy for chronic glaucoma, especially in cases in which the field of vision was contracted and involved the fixation point. When "operation" was spoken of, he thought it should be understood to mean decompression. In several cases he had obtained satisfactory fistulization without touching the iris.

The President said that in cases in which the tension was distinctly high and the fields were contracted, and there was a central scotoma, he advised operation. During recent years, the operation he had almost exclusively done was the trephine operation.

Mr. T. Harrison Butler read a paper on **infection after cataract operations,** in which he discussed some reasons for failure after cataract operations. There were two types of inflammation, having a different ætiology. The first was the acute wound infection, the septic hyalitis, panophthalmitis, most probably due to infection from without, mostly by the pneumococcus, often derived from a diseased sac or an ethmoiditis. In his second group the cause was mostly an endogenous infection, or due to general toxæmia. Diabetes he regarded as a fruitful cause of failure.

After an afternoon spent at the Royal London Ophthalmic Hospital inspecting and discussing clinical cases, the evening was devoted to a debate on **diabetes in relation to diseases of the eye.** It was opened by Sir Archibald Garrod, K.C.M.G., and Mr. R. Foster Moore.

Sir Archibald Garrod addressed himself chiefly to the subject of diabetic retinitis. In the diabetic form, the ocular hemorrhages were apt to be guttate rather than flame-shaped, the white spots more opaque and sharply circumscribed, more scattered and less apt to group themselves around the maculæ. But albuminuria in diabetes did not necessarily point to serious renal damage: the amount of albumin in renal cases gave no sure clue to the gravity of the kidney lesion. Albuminuric retinitis was met with in young patients, even in children. This suggested that the occurrence of retinitis in diabetes was not to be attributed to the accumulation of sugar in the blood, nor of the accompanying acetone bodies. A contributary cause must be looked for other than the disorder of carbohydrate and protein metabolism, and if it were true that the retinitis was associated with cardiovascular changes, this suggested an explanation. Most of the diabetic patients in his wards who had developed retinitis had evidences of renal disease also. He suggested that both diabetic and albuminuric retinitis was associated with high blood pressure and arterial changes. A line should be drawn between acute diabetic cases in early life, and the mild diabetes of middle life which might persist for many years without grave detriment to health. Cataract seemed to be the commonest eye trouble to which diabetics were specially liable. He urged the importance of diabetic patients being put through a course of hunger treatment before an attempt was made to operate on the eyes.

Mr. Foster Moore's paper discussed the subject in much detail, based upon careful observation of 62 cases. He said the chief ocular complications in diabetes were retinitis, cataract, retrobulbar neuritis, retinal and vitreous hemorrhages, lipæmia retinalis. Lesser conditions met with included alterations in intraocular tension, in refraction, also iritis and debility of accommodation. These he considered in detail. Retinitis had affected his older patients only: there was only one as young as 39: these usually had arteriosclerosis also, and sugar and albumin in the urine were common too. Diabetics tended to develop hemorrhages into retina or vitreous. The prognosis of retinitis in diabetics was much less grave than in renal retinitis: 60% of Nettleship's cases lived beyond two years. The term "diabetic cataract" should be restricted to the cases of somewhat rapid opacity of lens seen in young diabetic subjects: it was always bilateral, and of a diffuse homogeneous type. A certain number of diabetics developed defective vision, in some the cause being retrobulbar neuritis. Concerning alterations of refraction, a certain number of observers had noted a variation with the amount of sugar excreted: in most cases a decrease in the sugar output lessened the degree of the myopia.

The contributions were fully discussed. Dr. Cammidge spoke of observations on 350 cases of diabetes. He thought the age-incidence of cataract and retinitis which had been observed was only explicable by the chemical changes taking place in the body at the various ages. Glycosuria was not a disease: he had seen a number of young people who had persistent glycosuria which, however, was but little affected by changes in diet, and the health did not seem to suffer. Two main groups of diabetics could now be well established: the pancreatic and the hepatic. In the latter there was an increased formation of amino-acids, of which tyrosin was one, and there was an increased fat content in the blood, progressive as the patient became worse.

Dr. C. O. Hawthorne spoke of the association of ocular palsies with glycosuria, and of the fundus changes which might occur when sugar was present in the urine. Admittedly ocular palsy was a rare event in diabetes mellitus, therefore the glucose present in the latter could not cause the palsy. It was probably, he thought, a peripheral neuritis affecting the terminations of one or other of the ocular nerves.

Mr. R. R. James said all cases of cataract in diabetic patients in the hospital were first treated by the physician to lessen the sugar output before any operation was attempted on the eye. If it could be avoided, he preferred not to do iridectomy.

Mr. Burdon-Cooper spoke of finding tyrosin and cholesterin in lenses which had been removed from diabetic subjects. He had not yet tested such lenses for glycogen. He believed that the acids and ferments secreted by the ciliary body in the aqueous were responsible for the hydrolytic change in the lens.

The Prevention and Treatment of Ophthalmia Neonatorum.

Members paid a visit to a special hospital for the treatment of this condition, under the Metropolitan Asylums Board (St. Margaret's) and afterwards discussed the subject in the large room. The debate was opened by Dr. Gibbon Fitzgibbon (of the Rotunda Hospital, Dublin). Among 38,106 born in that institution in twenty-three years, the incidence rate of the disease was 0.24%. Practically during the whole of that time the Crédé prophylactic treatment was used. As soon as the child's head was born, the eyes were wiped clean of all mucus with swabs of boracic lotion, and after the child had been bathed, one or two drops of a 1% solution of silver nitrate were dropped into each eye. Often, he believed, the child was infected through passing through an unclean cavity. He expressed a strong faith in silver nitrate. He had found an efficient vaccine a strong help: the maximum dose for an infant was three to five millions.

Mr. M. S. Mayou (surgeon to the institution) entered into the subject thoroughly. He had found that the meibomian secretion contained the xerosis bacillus on the third day of life, and it was almost constantly present soon after birth. If the fœtus passed quickly through the vagina, the chance of infection was much lessened. In one instance the first child of twins was infected, the second escaped it. He uttered a strong warning against the use of silver nitrate by the inexperienced: for these, 10% protargol was safer. In the cases at this institution, the gonococcus was found in 60% to 65% of them: in the non-gonorrheal, the streptococcus was the only one of serious import. He said the question of immunity to the gonococcus needed more study than it had yet received: patients who had had one attack of gonorrhea were not rendered by any means immune thereby against another attack. He went fully into histological questions and the technique of treatment, setting forth the statistics of the institution. He concluded by some remarks on the training of students and midwives.

Subsequent speakers dealt with the matter in the light of their experiences at the various large cities, and the opener replied, elaborating his views for combating venereal disease, which was at the root of this trouble.

The meeting unanimously passed a resolution urging that teaching of students and midwives should be given in the institution on this subject.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

CLINICAL MEETING OF THE SECTION ON OPHTHALMOLOGY.

This was held on June 9th, Mr. W. T. Holmes Spicer, the President of the Section, presiding.

Mr. R. S. Charsley exhibited a specimen which had been pronounced as **perithelioma of the lid.** The family practitioner had mistaken the tumor for an ordinary meibomian cyst, and had incised it. When the patient came to Mr. Charsley he removed the growth, and for two months thereafter the man remained in good health. The temporal bone then commenced to enlarge, and the patient noticed that his vigor was diminishing. Two months later still he developed weakness of the spine, and ultimately spinal curvature, probably due to tumor recurrence in the vertebræ. Death supervened six months after the tumor first became prominent. There had been no recurrence at the original site.

Mr. Treacher Collins's view was that the growth was alveolar sarcoma, while Mr. M. S. Mayou considered it was perithelioma.

Mr. Leslie Paton related a case of his own in which though the endothelioma was apparently thoroughly removed from the orbit, there was subsequent spread to a number of other glands, and death was immediately preceded by a large mediastinal growth, of the same histological nature as the original one.

Mr. A. W. Ormond exhibited a case of **neuro-fibromatosis** (von Recklinghausen's disease). There was extensive pigmentation over the body, and a number of soft tumors. The main complaint was of headache and failure of sight: his vision in each eye was $\frac{6}{18}$, and he had optic atrophy following papillœdema. The Wassermann test gave a negative result. The hands and feet were larger than normal, and the supraorbital ridges very prominent: in addition there was some kyphosis. The systolic blood pressure was 105*mm*, the diastolic 80. Mr. Ormond thought the indication was some overaction of the pituitary body, probably following an affection of the fibrous tissue at the base of the brain. He exhibited skiagrams of the skull.

Mr. J. H. Fisher thought there had probably been some irritation of the pituitary gland, resulting in hypersecretion, and that this accounted for the acromegaly.

Mr. W. H. McMullen showed a case of **cyst of the iris.** There was in this case no history of injury resulting in implantation of epithelium. The tension of the eye was normal, and the condition seemed to cause the child no inconvenience.

Mr. Fisher and Mr. Treacher Collins thought there might have been an unnoticed puncture, and Sir William Lister spoke of the careless habit in some women of sticking needles and pins into handy pillows or cushions, on which the baby might be placed. A puncture of the eye might not be noticed at the time, and it would probably quickly heal. This view was supported by Mr. Ormond.

The President exhibited a patient with horseshoe shaped opacities in the cornea. There was only one complaint, namely of gradually diminishing vision during the last few years. Only a negative history was obtainable.

Mr. G. W. Roll showed a child with **herpes ophthalmicus.** The attack occurred in February last, simultaneously with chicken pox, the eruption remaining on the brow. Part of the eruption was along the course of the nasal nerve to the tip of the nose: the cornea also was involved. The association between herpes ophthalmicus and chicken pox had been frequently noted. He spoke of other recorded cases, as did the President and Mr. J. H. Fisher.

Mr. J. F. Cunningham showed a patient with a **mass which obscured the optic disk.** There was a history of trauma, and Mr. Cunningham thought it was due to a wound.

Dr. RAYNER D. BATTEN exhibited a patient with **superficial punctate keratitis,** of two years' duration, which had been very resistant to various treatments.

The PRESIDENT spoke of a similar case in which treatment seemed hopeless: eventually the condition seemed to wear itself out.

Mr. MCMULLEN'S second case was one of **congenital malformation in the outer canthus.** The outer extremities of the left lids were separated by a low pad or cushion of tissue covered with skin. The suggestion of an amniotic band and adhesions before the displacement seemed to him a plausible one.

Mr. TREACHER COLLINS was reminded by this case of a class which was described in the "Ophthalmic Hospital Reports" by Sir George Berry. In the cases shown by that observer there was a symmetrical flattening of the malar bones, leading to the impression that the patients were brothers. He thought the most reasonable explanation was that there was delayed closure of the cleft between the fronto-nasal plate and the superior maxillary plate at the outer canthus.

Mr. W. L. HINE showed a patient with a **malignant sebaceous horn,** in which there was a large recurrence, and great benefit had so far accrued from a single (eight-hour) exposure to radium. The case was still under observation.

Mr. T. G. DOYNE showed a case of **furrow keratitis,** and Mr. WALLACE exhibited some of the daylight glass which was due to the research at Cornell University.

BOOK REVIEWS.

I.—**The Ophthalmoscope,** a manual for students. By G. Hartridge, London. Sixth edition. 152 pages, 65 illustrations, and 4 plates. Phila. P. Blakiston's Son & Co., 1919. Price $2.00 net.

The many excellent features of this introduction to the use of the ophthalmoscope are so well known that this book has made a permanent place for itself. In this new (the sixth) edition the text has been revised and a few additions have been made. The colored drawings of the normal fundus are excellent and come up to the high standard that one looks for in English textbooks. Unfortunately the plates of the pathological changes are not only too few, but fail to illustrate the conditions described. With the exception of this limitation, the book admirably fulfills its purpose and will prove of great aid to the beginner.

A. K.

II.—**A Practical Treatise on Ophthalmology.** By Dr. L. Webster Fox, Professor of Ophthalmology, Medico-Chirurgical College Graduate School, University of Pennsylvania, etc. Second edition. 831 pages, 6 colored plates, and 300 illustrations. New York and London. D. Appleton & Co., 1920.

This treatise has been carefully brought up to date and revised so that it is practically a new book. The outstanding features are the clearness of the text, the excellence of the illustrations, many of which are original, the unusual details of operative procedures, and the many therapeutic suggestions. The latter two particularly reflect the enormous experience of the talented author. The student and practitioner in ophthalmology will find this a very practical guide to the study and treatment of eye diseases.

A. K.

III.—**The Blind.** Their condition and the work being done for them in the United States. By HARRY BEST, Ph.D. 763 pages. New York. The MacMillan Co., 1919. Price $4.00.

The interest in the blind has increased so much in recent years that an authoritative book on the subject is very timely. The author has collected an enormous amount of material which is of the greatest value. The subject is considered under the headings of General Condition of the Blind, Blindness and the Possibilities of its Prevention, Provision for the Education of Blind Children, Intellectual Provision for the Adult-Blind, National Provision for the Blind, Organizations Interested in the Blind and conclusions with respect to the work for the blind. This gives the scope of the book and shows its value for study and reference to those engaged in this important field.

A. K.

IV.—**Swanzy's Handbook of the Diseases of the Eye.** Twelfth edition. Edited by LOUIS WERNER, Dublin. With illustrations, 671 pages. Phila. P. Blakiston's Son & Co. 1919. Price $4.00.

It is fortunate that Swanzy's well-known and excellent textbook is continued in new editions under the able editorship of Dr. Werner, so that oncoming students of ophthalmology may profit by this scientific yet concise presentation. In this new edition diseases of the cornea have been reclassified, chronic uveitis is treated in a thorough, up-to-date manner, and recent investigations on the cortical visual center are given. Some new operations have been introduced, such as excision of lacrimal sac, transplantation of mucous membrane for trichiasis, and others. The completeness of the subject matter is quite astonishing, and the wealth of excellent illustrations, many of them in color, is noteworthy. There can be no better textbook for the student and it is a pleasure to recommend it.

A. K.

V.—**The Nose and Olfactory Organs.** By J. PARSONS SCHAEFER, Professor of Anatomy, Jefferson Medical College, Philadelphia. 370 pages. 204 illustrations of which 18 are printed in colors. Phila. P. Blakiston's Son & Co. 1920. Price $10.00 net.

This study of the nose, the paranasal sinuses, and the nasolacrimal passageways is based on the basic conception of the underlying genetic and developmental history. The work begins with general embryology and development of the nose, then comes the anatomy of the nasal cavities; the maxillary, the frontal, the sphenoidal, and ethmoidal sinuses are taken up in turn. The nasolacrimal passages are carefully described. Of practical interest to the ophthalmologist is that at best but papery laminæ of bone intervene between the ventral portion of the ethmoidal labyrinth and the lacrimal sac and the nasolacrimal duct. Congenital dehiscences are extremely commonplace. Close relation exists between the mucous membrane of the nasal and the nasolacrimal fields through an abundant network of lymphatic vessels. This explains the infection of the tear sac in many cases. The author furthermore suggests that the success or failure of non-surgical treatment of diseases of the tear passages is dependent on the anatomic type of the nasolacrimal duct and ostrium present. Probing of the nasolacrimal duct would seem ill-advised from an anatomic viewpoint. The nasal mucous membrane, the blood and lymphatic systems, and the nerves of the nose and accessory sinuses are the subjects of the remaining chapters.

The intricate anatomy of the nose has always been a favorite field for study and numberless textbooks and monographs have appeared in all languages. No book has been published which in the reviewer's knowledge can compare with this in completeness, in its scientific trend, and in its practical bearing to clinical problems. Its careful study will be of the greatest value to the ophthalmologist. The text is clear, the illustrations excellent, and the general make-up of the book could not be improved upon.

A. K.

VI.—**The Physiology of Vision, with Special Reference to Color Vision.** By F. W. Edridge-Green, M.D., F.R.C.S. Published by G. Bell and Sons, Ltd. London. 1920.

In presenting this work to the medical reading public the author has endeavored to elaborate upon the scientific knowledge of the physiology of the eye as a fitting introduction for his views upon color vision and color blindness. This is very ably accomplished. Well-known facts are interpreted in a rather new manner, or at least, new to the reviewer. In the opening pages, the doctrine of specific sense energy is elucidated in a most creditable manner. The dioptrics of the eye are likewise very clearly explained, and accommodation is made understandable to the merest tyro. The physiology of the iris is accurately disposed of in a few pages, and the optical defects of the eye are considered at sufficient length for the practical purposes of the work. The action of light upon the retina is discussed very carefully and is a differentiating feature of the work. The function of the visual purple is described in a scientific manner, and not left to the imagination as is so often the case in textbooks on ophthalmology. This entire section is very good. Anyone could read this and obtain a clear view of the subject. This is a characteristic of the entire book, however. Having been led this far very enjoyably through what usually is an ophthalmic maze, one is prepared to accept whatever theory the author may propound as gospel, and is not a little surprised and disappointed when he admits that "very little is known at present of the exact nature of visual impulses and their origin." His theory of vision depends upon the acceptance of the hypothesis that there is a thin layer of a photo-chemically sensitive fluid (the visual purple) corresponding to the sensitive plate of the camera. It is very probable, he states, that light acting upon the visual purple is according to its wave length absorbed by particular molecules, the amplitude of their vibrations being increased. These vibrations may cause corresponding vibrations in certain disks of the outer segments of the cones, which seem especially constructed to take up vibrations. Proceeding from this hypothesis, he elaborates upon the various observations in support of this contention, and disposes of those that seemingly oppose it. This is likewise ably done. The origin of light and dark adaptation is explained by his theory very well indeed. Visual acuity and after images are also well-described. The section on the variations of visual phenomena is especially attractive, and should help us to explain many disturbing symptoms to our patients. The section on binocular single vision is deserving of more than passing mention. As would be expected in a work by a specialist along one particular line, the section on color vision and color blindness stands in a class by itself. To attempt to abstract even a portion of it for purposes of review would be to risk mutilating it. The prospective reader is urged to study it carefully and he will be amply rewarded in knowledge and information. On the whole the book is most creditable to the author and is certain of a good reception. We wish to extend our congratulations to Dr. Edridge-Green, and to express to him our appreciation of a most enjoyable reading hour with this latest effort of his.

L. WEBSTER FOX.

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ARCHIVES OF OPHTHALMOLOGY.

DETACHMENT OF THE RETINA.[1]

BY DERRICK T. VAIL, M.D., F.A.C.S., CINCINNATI, OHIO.

AMONG the unsolved problems in ophthalmology there is none that is shrouded in deeper gloom than idiopathic detachment of the retina.

The ætiology is unknown. The pathogenesis is a mystery. The medical treatment is purely empirical and the many operations thus far advocated for its cure are not only disappointing in results but often actually disastrous. There is only one well founded hope in the disease and that is, if left alone there is a bare chance (1%) of spontaneous recovery.

It is a sad commentary on the sincerest efforts of the world's best brains working in ophthalmology for over seventy-five years seeking a cure for detachment of the retina, to say that so far as a reliable cure is concerned nearly all is vanity and vexation of spirit.

That a cure is often possible we must acknowledge from the fact that in those detachments associated with albuminuria in pregnant women nearly all recover if gestation is terminated early enough, that many cases due to trauma recover by rest-in-bed treatment along with the employment of simple therapeutic measures and that spontaneous cures occasionally occur in the idiopathic form even where no treatment is instituted.

The object of this paper is to offer some new thoughts with the hope that they may stimulate others and arouse discussion that may lead to a better understanding of the subject and to better results in the treatment of this dread disease.

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[1] Read by invitation before the Section on Ophthalmology, New York Academy of Medicine, May 17, 1920.

ÆTIOLOGY.

In the first place let us abandon the teaching that detachment of the retina is caused by intraocular strain, violent muscular strain, stooping, vomiting, constipation, sneezing, seasickness, etc., for if these produced the disease who would escape?

Next, let us acknowledge that myopia is not a cause, for in spite of the fact that approximately 50% of the cases occur among myopes, it is fair to estimate that not over one in one thousand cases of myopia ever has retinal detachment. Myopia *per se* is not a cause, otherwise the disease would be a scourge. How then may we account for the fact that approximately 50% of the cases occur among myopes? Certainly it is not because the sclerotic wall is too large for the vitreous contents thus causing spaces to form behind the choroid and in front of the retina as taught by L. Mueller and others, for in most of the cases of detachment in myopia the amount of bulbar enlargement is negligible, moreover we see large numbers of patients where the eyeball is greatly enlarged where no detachment occurs, and contrariwise we see many detachments among hypermetropes where the eyeballs are small.

My theory is that disease of the pars ciliaris is the essential factor predisposing to detachment, especially that form which tends to travel forward to finally reach the ciliary processes. No name has been given to this pathological entity; it is allied to anterior choroiditis or equatorial choroiditis. This disease is more frequently seen among myopes, perhaps incited by the drag on this region by the tensor choroidea muscular fibers in the straining effort these myopes employ in trying to see off without lenses or with under-correction, and aided perhaps by atrophy of Mueller's ring muscle fibers lying in close proximity to the ciliary processes. This region becomes the seat of chronic congestion in such myopes and therefore subject to inflammation especially, in the presence of chronic infection in the blood supply. But fully 25% of the cases of detachment do not have myopia. I have searched the region of the ora serrata in the unaffected eye in quest of equatorial choroiditis among hypermetropes with detachment of the retina in one eye, and have found it in nearly every instance. What produces the anterior choroiditis? We do not know unless it be bacterial poisons in the capillary blood stream or chronic septicæmia from showers of pathogenic germs thrown in the circulation from hidden and silent areas of sepsis elsewhere in the body as abscesses in the bone about the apices of the teeth, septic tonsils, chronic ethmoiditis or other accessory nasal-sinus disease, remote neglected chronic suppurations, etc. These autogenous infections are very common and they tend to settle in a strained or congested part; that is as much as we know about it at present.

Let us look further into the list of causes as enumerated in our modern textbooks of reference. Horner studied 300 cases and submitted the following statistical table with reference to predisposing causes:

Myopia........................	144	cases	48.0	per cent.
Trauma........................	49	"	16.3	" "
Iritis and Uveitis................	11	"	3.6	" "
Choroiditis......................	10	"	3.3	" "
Hemorrhagic Diathesis...........	23	"	7.6	" "
Congenital Anomalies............	2	"	0.6	" "
Congestive Causes...............	11	"	3.6	" "
Opacities in the Vitreous.........	22	"	7.6	" "
Idiopathic......................	28	"	9.3	" "

(Woods's *Encyclopedia*, vol. xv., 11,214.)

It is significant that there was undoubtedly present among many of these three hundred cases a disease affecting the ciliary zone. Even the idiopathic cases may and probably did have unrecognized disease of this region.

In 1912 in a paper on "Detachment of the Retina" read at the Niagara Falls meeting of the American Academy of Ophthalmology and Oto-Laryngology I proposed the theory that the symptom, detachment of the retina, was the logical consequence of paralysis of secretion of the aqueous humor due to disease or shock affecting the secretory cells of the ciliary processes. (See "An Inquiry into the Results of the Established Treatment of Detachment of the Retina, and a New Theory," *Annals Ophthal.*, Jan., 1913, and Trans., 1912.) Quoting from that paper:

"My theory is that there is a paralysis of the secretory function of the ciliary processes. This means that the secretion of aqueous is suddenly arrested. There being nothing wrong with the drainage channels within the eye, the watery elements find ready egress thus causing a minus tension. Leber found 90% had minus tension. The withdrawal of normal tension causes passive hyperæmia of the blood vessels of the tunica vasculosa. This allows diapedesis and transudation. The vitreous contracts because it loses its percolating supply of aqueous which soon drains off through the efferent channels which are wide open, and the fibers of the vitreous naturally contract as a sponge would contract after losing its water."

It is common knowledge that in detachment of the retina the vitreous body is shrunken and toughened. Leber and Nordensen held that at first there are fibrillar changes in the vitreous which cause shrinkage and occasion traction on the retina through adhesive bands; this, they claim, drags the retina off its bed and causes rents in it for fluid to pass from the vitreous cavity back behind it (traction theory). Raehlmann held that there was serous exudate from the choroid which diffuses through the retina and hyaloid according to ordinary physical laws. The watery elements of the choroid-exudate diffuse on through, leaving the heavier albuminous exudate to become concentrated behind the retina, and accumulating there, lifts it off its bed (diffusion theory). Collins and Mayou state the objection to the diffusion theory is that in retinal detachment the tension of the eye is not increased but decreased and that Raehlmann's theory necessitates the disappearance of at least a corresponding quantity of the contents of the vitreous chamber. This disappearance of normal vitreous contents, they state, is exceedingly difficult to account for. The same criticism holds against Leber and Nordensen's theory. Deutschmann showed by experiment that when the ciliary body was extirpated there was complete cessation of aqueous production and in a short while the vitreous shrunk and was apparently absorbed.

It seems strange that no one has suggested that the reason the vitreous shrinks in detachment of the retina is because the aqueous has ceased to form; that the secretory cells are paralyzed from some cause or other.

Violence alone does not seem to produce detachment of the retina unless some such disease of the ciliary zone, as suggested in the term anterior choroiditis is present. In proof of this there is nothing which produces greater violence to the intraocular structures than extrusion of the greater part of the vitreous such as occurs in the cataract operation in the case of "squeezers." Everyone who operates for cataract will grant that, while theoretically every case of profound vitreous escape should have detachment of the retina, the fact is that it does not occur in more than 5% of such cases, and I believe it is fair to say that in each case where it does occur there was a predisposing pathological condition already present in the eye before the operation, and further, that in those cases in which detachment of the retina occurs as a late symptom, disease in the equatorial and ciliary zone eventuated because of the trauma aided perhaps by a quiet infection in this region and that finally there resulted paralysis of the secretory function of the ciliary processes.

In the case of detachments occurring as the result of albuminuria in pregnant women, in which we may see the frank evidences of plastic inflammation in the retina and elsewhere, with the ophthalmoscope, it is interesting and significant that rapid replacement of the retina with restoration of normal tension and often normal vision usually occurs if the gravid uterus is promptly unloaded. It is a clinical fact that induced labor soon rids the blood of the toxic substances in these curious cases and the general anasarca, the pronounced albuminuria, the uræmia, the eclampsia and in fact all the symptoms including the neuro-retinitis disappear magically. Facts are stubborn things and will not be argued away. It must be that the cause being removed, the exudations and poisons undoubtedly present in these cases also disappear, and the secretory function of the ciliary processes which was paralyzed by them, speedily returns and establishes a cure.

THE MECHANISM OF DETACHMENT OF THE RETINA.

To understand the mechanism of detachment of the retina we must begin at the beginning and consider briefly that part of the embryology, histology, anatomy, and physiology of the retina and ciliary processes which bears on the subject, for it is from these sources of knowledge that we must base our explanation of the disease.

In the embryo the primary optic vesicle soon becomes invaginated, as regards its anterior half, forming the optic cup. The invaginated portion develops into the retina proper. The posterior half becomes attenuated and finally reduced to a single layer of polygonal cells highly pigmented and finally constitutes the pigment layer of the retina. The rods are pressed against this pigment layer by the normal intraocular pressure contained in the vitreous body. The space between the retina proper and its pigment layer never becomes completely obliterated. This interspace is occupied by a clear fluid substance constituting a modified lymph. It is well-known that the pigment layer adheres to its basement membrane, the lamina vitrea of the choroid, in retinal detachment, and it is taught that at no place is the retina adherent to its pigment layer excepting at the optic-nerve entrance and at the ora serrata. The sustentacular fibers of Mueller hold the integrity of the retina against splitting in case of ordinary strain but these fibers do not pass across the space lying between the rods and the pigment layer. At the pars ciliaris the retina completely loses its structure and passes on forward as a single layer of cells being, however, in contact with the pigment layer which also continues forward.

From this anatomical description it will be seen why the retina separates from its pigment layer as soon as there exists a marked lowering of intraocular tension together with a transudation of serum from the choroid. It is a well-known clinical fact that the ocular tension in detachment of the retina is always less than normal. It usually falls to 20*mm* of mercury or even less. The tension must fall because the aqueous secretion is arrested. If the aqueous secretion continued and serum exudate from the choroid was added the tension would surely become plus. The normal vitreous and aqueous humors are identical excepting that in the former there exist bundles of clear fibers, in the spaces of which aqueous abounds like water in a sponge. The normal function of the ciliary processes is to secrete the aqueous as a constant stream in the vitreous chamber as well as filling the aqueous chamber. In health there is a nice physiological balance maintained between the secretion of aqueous and its outflow.

If, from any cause, the secretory cells of the ciliary processes are damaged from progressive disease there will come a time when a slight insult to the eye like dazzling, straining, etc., will cause paralysis of function and the result will be that little or no aqueous will be secreted. Normal tension being thus lowered there is negative pressure against the retina and the choroidal vessels become passively hyperæmic allowing serum to pour out through the pigment layer to reach the anatomical space that exists between the rods and the pigment layer. Here the thick serum collects and the retina is separated. This serum is probably hypertonic as compared with the vitreous and so the osmotic pressure is under the retina; this is sufficient to strip the retina off its bed and even to burst it in some cases.

The aqueous of the anterior chamber is highly albuminous in detachment of the retina. Suker of Chicago has written me that he tapped the anterior chamber and drew off the aqueous in three cases of detachment of the retina and found it very albuminous. This in the presence of hypotony strongly argues that the normal aqueous flow has ceased.

The detached retina holds its integrity for a while by virtue of its sustentacular fibers and spider cells but rents or lacerations usually occur owing to the higher osmotic pressure in the subretinal fluid.

THE MECHANISM OF AQUEOUS SECRETION.

It is interesting to apply the knowledge of modern physiology to the study of the aqueous secretion. Macleod (*Physiology and Biochemistry in Modern Medicine*, 1919, page 420) states the secretion of water and inorganic salts from the blood may be dependent to a certain extent at least on differences in osmotic pressure. We know when an osmotically active substance is confined in a tube having one end closed with an impermeable membrane and the other end closed with a permeable membrane and the tube be immersed in water, a continuous current will issue from the permeable end so long as there remains any osmotically active substance within the tube. The living secretory cell is the microscopic tube containing the osmotically active substance, the end next to the basement membrane the impermeable and the other or free end the permeable one. So long as the content of the cell is osmotically active the cell will secrete water. The process is, however, more complicated when we consider that the cell must be under the control of the nervous system or else receive its impulse to carry on abstraction of water from the blood and discharge it into the vitreous chamber as aqueous under the influence of a hormone. A hormone is a chemic substance produced in an organ which being carried to an associated organ by the blood stream excites in that organ a functional activity. There are two theories as to the effect of such a hormone on the living secretory cell, one is that there is a permeability of the free end of the cell brought about by alteration of the surface tension by the migration of electrolytes to this end of the cell through electric influence, thus favoring the passage of the water elements and some of the inorganic salts. The other theory is that there exists a ferment in the cell called zymogen and these zymogen granules cause the molecules within the cell to imbibe water until they swell and burst at the periphery of the cell the contents to be discharged as water bearing some zymogen and inorganic salts. The residual cell-content becomes concentrated by the discharge of its water and it in turn attracts more water to go through the same process. By this physiologic process there is a constant flow of water from the secretory elements of the ciliary processes.

Ninety to 92% of blood plasma consists of water. The specific gravity of the aqueous is 1.005 while that of the blood is higher, viz., between 1.040 and 1.065. The velocity of the blood in the capillaries is one half of one millimeter of distance in one second. Thus the hypertonic plasma is in slow contact with the cell and its osmotic pressure is toward the secreting cell.

Certain glands like the salivary have periodic activity and are under direct nervous control whereas other glands like the ductless and the ciliary are not under nervous control, at least in the same sense, but are continuous in function. Modern physiology teaches that these are under hormone control. Those glands which are under periodic nervous control secrete during activity a thick fluid containing a large amount of organic matter, while those under hormone control incite a constant flow of thin, watery fluid containing scarcely any organic matter.

The hope contained in this tedious recital of some of the simpler processes involved in the mechanism of aqueous secretion is that the active ferment, hormone, or zymogen which incites the flow of aqueous may be discovered, extracted and used with success in cases where there is a lack of aqueous flow in a manner analogous to the action of secretin on the pancreas.

TREATMENT OF DETACHED RETINA.

In applying these principles to the therapy of detachment of the retina the problem seems to be to reverse the vicious osmotic pressure and establish if possible a hypertonic vitreous content and a hypotonic subretinal content, thus causing higher osmotic pressure within the walls of the vitreous chamber in front of the retina, and thereby convert a *vis-a-tergo* to a *vis-a-fronte*. In spontaneous cures the reëstablishment of aqueous secretion accomplishes this result. The therapeutic measures that have been successful in curing cases seem to me either to effect this change of osmotic pressure or else establish a makeshift.

If trephining the sclera to drain the subretinal sac cures, it would be by destroying the osmotic pressure of the fluid behind the retina by draining it off as fast as it forms.

The benefit derived in cases of subconjunctival injections of salt water, dionin, etc. may be explained on the theory that they tend to lower the osmotic subretinal pressure. Pilocarpine increases secretion and atropine is thought to retard intraocular drainage and so the benefit of pilocarpine may be found in the increased aqueous secreted from its use while atropine may tend to block the channels of exit and raise intraocular tension somewhat, thus either may to a certain limited degree inhibit the perverted osmotic pressure.

As for creating adhesions between the retina and its pigment layer by injection of irritant solutions like iodine in the subretinal sac, cutting through the retina to induce adhesive inflammation, suturing the retina to its bed, scarification of the sclera, galvano-puncture, and all such measures, they are to be strongly condemned for the reason that even if successful they are open to the stern objection that they are designed to create an adhesion through plastic exudate and cicatricial formation between the ultimate layers of the retina where no adhesion ever existed without destruction of vision. This theory seems founded on vicious ignorance of the embryology and physiology of the retina and its practice is cruel.

Time forbids me to say more. I only wish to call your attention again to my paper of 1912 wherein I published accurate reports from 281 leading American ophthalmologists going to prove that by the employment of every known method of treatment and operation, the cases of cure were of startling paucity figuring about one case in one thousand. Two hundred and fifty of those busy ophthalmologists with an average experience of over twenty years had never seen a single cure spontaneous or otherwise. In the light of this, anyone may be pardoned for abandoning the beaten paths and daring to seek and explore new avenues of thought with the hope that some one of them may lead to the light.

FURTHER EXPERIENCES WITH TREPHINING AND ASPIRATION IN RETINAL DETACHMENT.[1]

By Dr. EDGAR S. THOMSON, New York.

THIS method of operating on cases of retinal detachment was reported by Dr. T. H. Curtin and the writer in the *Transactions of the Section on Ophthalmology of the A. M. A.* for the year of 1915. A further contribution to the subject was printed in the *Annals of Ophthalmology* for January, 1916. The first operation was done by Dr. Curtin on October 12, 1914. Up to the present time about seventy-five operations in all have been done by various members of the staff of the Manhattan Eye, Ear, and Throat Hospital, with seven successes. The successful cases are briefly as follows:

Case 1.—B. Male, 21, spontaneous detachment of twelve days' duration in lower half of left retina. L. V. = Hand movements. Trephine, October 12th, aspiration ten days later through trephine opening, and 25*m* of fluid withdrawn. Complete reattachment except for a very small area over trephine opening. November 16th, L. V. = $\frac{20}{40}$ w. – 1 cyl. ax. 180°. January 27, 1915, L. V. = $\frac{20}{20}$ w. – 1.50 cyl. ax. 180°. He was last seen in May, 1918. The conditions were unchanged. Vision was normal and the reattachment was complete. Case reported in *Tr. Sec. of Ophth. A. M. A.*, 1915.

Case 2.—W. Male, 23. Struck in right eye November 13, 1914. Came to hospital December 8th, with large detachment in upper and outer part of field. R. V. = Fingers at one foot. Trephine December 12th by Dr. Thomson. Aspiration through trephine opening December 22d and 20*m* of fluid withdrawn. Complete reattachment, except a small area, near a choroidal spot in lower part of field. R. V. = $\frac{20}{70}$. Three months later no change had occurred. Case reported in *Tr. Sec. of Ophth. A. M. A.*, 1915.

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[1] Read before Section on Ophthalmology, New York Academy of Medicine, May 17, 1920.

CASE 3.—F. Female, 54, cataract extraction L. in 1912. Spontaneous detachment lower part of field October, 1915. Trephine and aspiration done by Dr. Curtin two weeks later. Reattachment except for small area near opening. L. V. = $\frac{20}{40}$ with lens. Case seen seven months later and found unchanged.

CASE 4.—H. Male, 45. Flat spontaneous detachment in lower part of field for seven months. R. V. = $\frac{20}{50}$ (eccentric). May 19, 1916, trephine and aspiration by Dr. Thomson and 12*m* of fluid withdrawn. Complete reattachment. June 5, '16, R. V. = $\frac{20}{30}$ w. − 3 ◯ − .50 ax. 15°. Last seen September 23, 1919. Condition unchanged. R. V. = $\frac{20}{30}$ + w. − 4 ◯ − .75 ax. 15°. This eye had an old sun-spot and $\frac{20}{30}$ is probably the best vision he had had for some years.

CASE 5.—R. Female, 32. Large spontaneous upper detachment in right eye for three months. R. − 10 D. L − 2D. R. V. = hand movements. February 11, 1916, trephine and aspiration by Dr. Thomson and about 30*m* of fluid withdrawn. Reattached but detached below later. Seen March 10th, with two large pouches below. May 9th, second trephine and aspiration below. Complete reattachment. June 6, R. V. = $\frac{20}{100}$ w − 6. April 2, 1919, R. V. = $\frac{20}{100}$ + w − 7. Some diffuse choroidal changes but eye otherwise in good condition. Married and mother of a child six months old.

CASE 6.—B. Male, 62. Seen September 14, 1916. Left eye lost by retinal detachment six years previously. R. V. = fingers at 2 feet in lower field. Vision in right failed early in July, 1916. Flat detachment in lower half of retina. Had chronic interstitial nephritis. October 7, 1916, trephine and aspiration by Dr. Curtin and 15*m* of fluid removed. Complete reattachment. October 30th R. V. = $\frac{20}{100}$ + w. + 2.50 ax. 90°. April 20, 1920, condition unchanged. Some floating vitreous opacities.

CASE 7.—G. Male, 26, detachment R. lower 10 days. R. V. = $\frac{20}{100}$ (eccentric). Trephine and aspiration September 26, 1919, and 10*m* of fluid withdrawn by Dr. Dean Foster. Complete reattachment. L. V. = $\frac{20}{40}$. No change to date.

The remaining cases were all flat failures, or at most, secured only temporary benefits as far as we know. It should be noted, however, that almost all cases improved temporarily but that the detachment recurred if complete adhesion was not secured.

The technic of the operation does not differ materially from the original description, except that in our later cases the trephining and aspiration have been done at the same time. A curved incision is made about eight or ten millimeters long through conjunctiva and capsule and the sclera is bared. Two sutures are inserted into the edge of the flap and are used to retract it. A *2mm* trephine button is then removed from the sclera as far back as possible over the area of detachment and any suprachoroidal fluid is allowed to escape. The detachment is then observed with an electric ophthalmoscope and the needle of a Kny-Scheerer "Record" syringe is introduced through the choroid well back into the middle of the detachment. As long as the piston of the syringe works easily the fluid is withdrawn but if difficulty is experienced the position of the needle is shifted or it is removed, and after further ophthalmoscopic examination the needle is entered again, the object being to remove the fluid completely if possible. After all of the fluid is removed, the conjunctival flap is sutured in place and the operation is complete.

Our experiences have developed certain interesting facts. The retina does not loose its function as rapidly as has been supposed. In one case (No. 4) the detachment had existed for seven months with only a slow rate of increase and vision was completely regained. A blur remained in the field for about four months after the operation but this finally disappeared and the field is now normal. It is interesting to note an immediate increase in function when the retina is replaced. After the fluid is removed rough visual tests on the operating table will almost always show an increase of vision which seems more than would be accounted for by the mere position of the retina. This improvement almost always occurs as a temporary condition. It seems probable that in certain cases success may be secured even if the detachment has existed for six months or longer, provided perception of light in the detached area is retained.

It seems absolutely useless to operate in the presence of a well-developed retinal rent. We have never had the slightest indication of success in such cases. Also if rents develop in the course of treatment, as they are apt to do, all further operative work may as well be abandoned. It is probable that the fluid enters the sub-retinal area from the vitreous in such cases. In case No. 4 the retina was beginning to show marked signs of thinning at the periphery but no actual rent had occured.

It is of distinct advantage to keep the patient on a low protein, low fluid, diet before the operation is undertaken. Any toxic condition should be under control particularly if the case presents any appearance of choroidal inflammation.

All the fluid must be removed at the time of the operation even if the globe collapses markedly. Any fluid which remains does not absorb, or perhaps it would be better to say that if the retina is kept from adhering to the choroid more fluid seeps in and the detachment continues. While repeated aspirations may be done the chance of success is probably better at the primary aspiration than it ever is later, though a secondary operation may prove successful as is shown by Case 5. This same case shows that a high degree of myopia is not an insuperable obstacle to success though it undoubtedly makes the prognosis much more doubtful. Myopia may diminish one or two diopters after a trephine, though it usually recurs to the full amount. Case 5 is most probably at least 1 D. lower than before the two trephines. This tendency is mentioned by Holth in his paper at the meeting of the Heidelberg Ophthalmological Society for 1913.

The larger the amount of fluid the more slender the chances of success, though a large amount of fluid does not materially add to the post-operative reaction, which is usually slight. We have removed as much as 40*m*. The presence of fluid in the suprachoroidal space is a somewhat favorable sign. It seems that such cases do better than when the fluid lies entirely in the sub-retinal space.

Marked vitreous opacities are a distinct disadvantage in the operation and such cases are apt to cloud up with further infiltrations. It seems probable that the trephine opening, by the lymphatic changes it produces, has a tendency to hold off the iritis which formerly was such a dreaded complication in retinal detachment. It may be of some benefit in holding off inflammation even where the detachment goes on to absolute blindness. The tension does not remain permanently lowered after the operation but returns to normal in a few weeks. Infection at the site of the opening does not occur as in trephining at the limbus, probably on account of the greater thickness of the flap. Nor does a bleb exist for any length of time although there is probably some steady loss of intraocular fluid for some weeks. Ultimately the area of the opening smoothes out and it can hardly be seen where the opening was.

Finally the old difficulty of lack of retinal healing power comes into the question as actively as ever and seems in the great majority of cases to interfere with ultimate success. For this reason it is undoubtedly a mistake in the after treatment to overdo the period of rest in bed. If the retina is disposed to adhere, a week or ten days in bed is probably sufficient while if complete re-adhesion is not secured the detachment increases sooner or later no matter how long the patient is kept flat on the back.

INTRANASAL DACRYOCYSTOSTOMY.

By Dr. C. F. BOOKWALTER, Chicago

(*With three illustrations on Text-Plate XIX.*)

THE object of the operation is to establish a new, permanent opening from the lacrimal sac into the nose. It is indicated in cases of chronic obstruction of the lacrimal passages in lower part of the sac or in the nasal duct and not in cases with tearing due to other causes. Most of my cases presented the usual pictures of chronic purulent dacryocystitis in one stage or another but there were some with a collection of clear fluid in the sac in which tearing was the chief complaint.

The establishment of the new opening, if properly done, invariably relieves the suppuration or accumulation of fluid in the sac and there will be no tearing, if the passages from the eye to the sac are in good condition. Some cases with slit or otherwise defective canaliculi will have a little tearing with certain positions of the head. The best results, so far as tearing is concerned, are to be expected where the canaliculi are normal. The new opening will not close if properly made at operation, though some, about one out of ten in my series, require a little after treatment. The results of the operation are most pleasing to the patients, especially since its success is usually apparent almost at once and the relief is complete and permanent. My fifty-five operations were done on fifty-three patients, two having both sides done. Of the fifty-three patients, forty-four were females and nine males, the oldest being seventy-five and the youngest sixteen years of age. I have not seen a case in a small child where this procedure was indicated. The operation seems to be free from danger, there is little bleeding and not much pain. All of my cases were done with local anæsthesia. The time required for the operation varies of course. I have never done one in less than twenty-five minutes. Forty-five minutes would be a reasonable average time. The patient should be in a hospital and on a table during the operation, and as a rule the patient will be able to leave the hospital twenty-four hours after operation. There will be a few cases, three in my series, in which the septum will have to be straightened to obtain sufficient room. I have never found it necessary to disturb the turbinates in any way.

It is not within the purpose of this paper to enter into a discussion of the diagnosis of dacryocystitis but there are certain points having a direct bearing upon the operation which should be observed in preliminary examination. The anterior part of the nose is lightly cocainized and a drop or two of 4% cocaine put in the eye. If after shrinking the nasal mucosa, a clear view can be obtained of the lateral edge of the anterior end of the middle turbinate, there will be sufficient operating room. A few cases, as I have said, will require straightening of the septum to obtain working room, but with experience the number of such cases will be negligible. Attention is next directed to the canaliculi. A No. 1 Bowman probe is passed through the canaliculus, preferably the lower, into the sac. If the canaliculi are both closed, intranasal dacryocystostomy probably will not be the operation of choice. The punctum may have to be dilated to admit the probe, but slitting of the canaliculi should not be done.

SPECIAL INSTRUMENTS REQUIRED FOR THE OPERATION.

In addition to the usual equipment for nasal operating there should be:—a No. 1 Bowman probe, West's curved gouge, West's chisel, West's right angle knife, a malleus hook, and a universal handle to which can be fitted West's punch forceps and the author's right and left up-cutting punch forceps, which are of a size that can be introduced into the sac after it has been opened.

THE OPERATION.

The patient is placed upon a table and a suitable dose of morphine given, if considered necessary. A mixture of equal parts of a 10% solution of cocaine and a 1 to 1000 adrenalin is made. The nasal mucosa, in front of the middle turbinate, is swabbed once or twice with this mixture and a drop is placed in the eye, to be repeated once or twice as may be needed. A 2% solution of novocaine to which has been added a few drops of adrenalin is next used. With a suitable syringe the area of the lateral wall of the nose in front of the middle turbinate and above the inferior turbinate is injected with the novocaine solution, the injection being made under the periosteum. It is well to inject the anterior end of the inferior turbinate also. Using an ordinary hypodermic syringe, the novocaine is next injected from the outside. The needle is thrust through the skin just below the inner angle of the eye so that the point is within the lacrimal sac and the sac is filled with the solution. The point of the needle is then moved about in such a way that injections can be made into the walls of the sac and between the sac walls and the surrounding bone on the nasal side. It is important to anæsthetize the sac as it is the only very sensitive tissue encountered during the operation.

The first incision made in the nose is the one making the anterior edge of the intended opening and should be a little in front of and parallel to the anterior edge of the sac and nasal duct. The place to make the incision can be located approximately in two ways. The posterior edge of the sac and duct is about as far back as the anterior edge of the middle turbinate and one can measure the approximate width of the sac from the middle turbinate to make the first incision, A—B, Fig. 1. However, with experience, the position of the sac and duct with reference to the lateral wall of the nose can be estimated very well if the operator, having first put a speculum in the nose, looks back and forth from the angle of the eye to the lateral wall of the nasal cavity. This control should always be used as the position and shape of the middle turbinate vary considerably. Having made the location, the incision A—B, Fig. 1, is made, using the right angle knife, from a point a little higher than the attachment of the anterior end of the middle turbinate down to the inferior turbinate. The incision is carried to the bone. The second incision, C—D, is made with a knife having a concave cutting edge, and is car-

ILLUSTRATING DR. BOOKWALTER'S ARTICLE ON "INTRANASAL DACRYOCYSTOSTOMY."

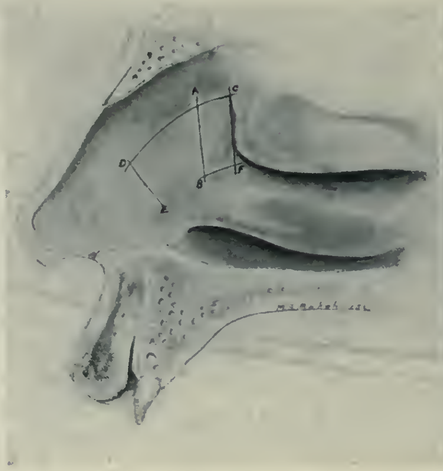

FIG. 1.

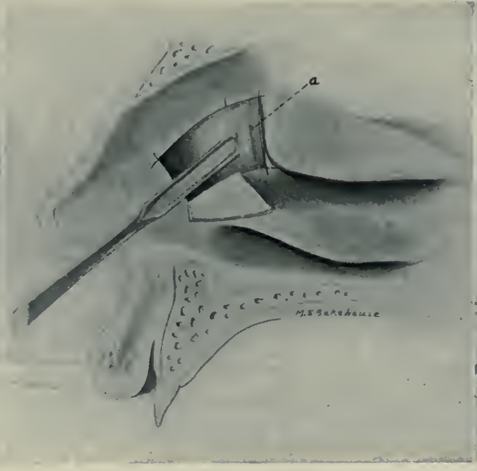

FIG. 2.

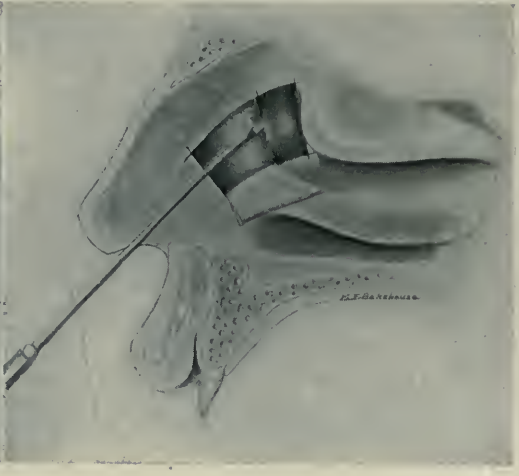

FIG. 3.

ried forward to the anterior edge of the nasal process of the superior maxillary bone. The third incision, D—E, is made with the right angle knife a little back of the anterior edge of the nasal process. There is now an area of muco-periosteum cut on three sides. This is elevated from the bone and falls down toward the floor of the nose. The object of the flap, which is to be replaced when the operation is complete, is to give a better view of the field. This step is not absolutely necessary but it is advantageous and does no harm as the flap always reattaches. After incisions C—F and F—B are made the oblong piece of muco-periosteum A—B, F—C, is removed from the nose. The position of the sac and duct with reference to the exposed bone is next to be made out and can be done in the same way as in making the incisions. In addition the articulation of the nasal process and lacrimal bone can be seen and felt with a hooked probe, A, Fig. 2, also a slight elevation can be seen in the nasal process as it curves over the sac and duct. This prominence is the first point of attack on the bone. The curved gouge is placed as in Fig. 2, and a few strokes with the hammer breaks off enough of the nasal process to expose part of the sac. A No. 1 Bowman probe is passed through the canaliculus into the sac and the nasal side of the sac can be seen to move as the probe is pressed against it. The operator is thus sure that part of the sac is exposed and it becomes simply a question of using instruments till the full width of the sac and duct is exposed from a point corresponding to the angle of the eye down nearly to the inferior turbinate. The sac is not to be opened till the bone opening is as large as described and has smooth edges. During this stage, no bone should be removed except part of the superior maxillary and lacrimal bones, but should an anterior ethmoid cell be opened, no harm is done. The nasal wall of the sac is now pushed out into the nasal cavity by pressure on the Bowman probe, or it may be pulled into the nose with a small sharp malleus hook. Using a small knife, such as is used to incise an ear drum, an incision is made into the sac and duct as far forward as possible and the full length of the exposed part, Fig. 3. The opening in the sac is completed with the knife and punch forceps till it is as large as the bone opening. This is the most difficult part of the operation, as it is hard to see exactly how large the sac opening has been made. Of course the Bowman probe will now pass freely through the opening into the nose and by moving it around one can tell much about the condition of the opening. It is absolutely necessary for the success of the operation that the openings in the mucosa, bone, and sac be large with smooth edges. The opening always becomes smaller during the healing process which cannot be said to be complete till the edges of the opening are smooth and covered by epithelium. The flap laid down at the start of the operation is replaced and the nose lightly packed. At the end of twenty-four hours the packing is removed and the patient may leave the hospital. The patient must be instructed not to blow the nose for several days as air might be forced into the tissues.

Following the removal of the packing, the nose should be treated as after any other nasal operation. There will be a little bleeding after removal of the packing and the nasal cavity will be more or less closed by swelling of the mucosa for several days. After four to five days, the swelling will have subsided enough so that the wound can be inspected. The new opening is to be inspected every four or five days for about eight weeks. It is well to pass the eye probe occasionally to outline the opening better. Usually no after treatment other than inspection and keeping the nose clean will be required, but in some cases, enough granulations will form around the opening to partly close it or to prevent the formation of smooth edges covered by epithelium. If this occurs the excessive granulations must be removed with forceps or electric cautery to prevent the possible closure of the opening.

A case cannot be said to be cured till certain conditions are observed. All evidence of inflammation and suppuration must have disappeared. The opening must have smooth edges without granulations. Even after granulation ceases the opening contracts, but at the end of about two to three months contraction ceases in a properly operated case. There will be no tearing if the above conditions are present and the canaliculi are in good order. The eye looks perfectly normal and the patient says that it is just as good as the other eye at all times.

Of the 55 cases reported, 12 were done in 1915, 14 in 1916, 12 in 1917, 10 in 1918, and 7 in 1919. I have not included cases in which less than a year has elapsed since operation. Among these were cases of all degrees of severity. All were chronic cases requiring operative treatment in the opinion of competent ophthalmologists. Nearly all had gone through the usual treatment, such as probing, dilating, or slitting of the canaliculi. Several came to operation with fistulæ into the sac discharging pus over the face. All of the cases were relieved of suppuration or accumulation of fluid in the sac and all have remained well. Six of the fifty-five could not be followed longer than a year after operation but were well when last seen. Three had a little tearing after the operation but in these cases the canaliculi were very defective.

Two cases are of special interest. Each had had the sac removed on one side with an excellent result as far as suppuration was concerned but tearing was a disagreeable feature. Intranasal operation was done on the other eye in each of these patients for chronic dacryocystitis. The results were good and both patients said they very much preferred the second operation on account of there being no tearing.

I have observed no case in which there has been a complete closure of the opening though six have required treatment with punch or cautery after the operation on account of partial closure by granulations. All of these obtained good results in the end.

CONCLUSIONS.

The results of the operation are ideal if the opening is made large with smooth edges and treatment carefully carried out to prevent excessive granulation till healing is complete.

Suppuration is invariably relieved.

There is no tearing if the canaliculi are even in fairly good condition.

It is much better not to slit the canaliculi.

The worst thing that could happen after operation would be the closure of the opening. Even then either a secondary intranasal operation or an external operation could be done.

Considering the structures involved in the operation it is difficult to see how a serious complication could arise.

I wish to express my thanks to Dr. Brown Pusey not only on account of his having referred many of these cases to me but also for his kindly advice and encouragement.

BILATERAL GLIOMA. REPORT OF A CASE UNSUCCESSFULLY TREATED WITH RADIUM.[1]

By Dr. ARNOLD KNAPP, New York.

THE occurrence of glioma in both eyes, estimated at 20% of the cases, is regarded as the localization of a primary tumor in the two eyes; *i. e.*, the growth in the second eye is not an extension from the first. In this bilateral localization the condition is usually observed in the early years, in 94% of the cases the patients were under four years. The involvement of the second eye is generally noted at the same time with that in the first eye, but the growth is less advanced. Occasionally the growth in the second eye is observed some time later; in a few cases long intervals elapsed between the enucleation of the first and the affection of the second eye. It is possible that the condition in the second eye has been overlooked, or as Leber says, the beginning may be microscopic and hence escape even careful ophthalmoscopic examination.

Always congenital the tumor at first passes through a stage of very slow growth when it may be quite latent and it is only the late stages which show a rapid growth and cause symptoms.

Length of interval between the Involvement of the two eyes. A number of cases are on record where the interval between the involvement of the first and second eye was three and four years.

Thus Vetsch[2] reported a case in which the interval was three years between the onset in the first and the second eye. Von Grollman[3] observed a case with 4 years' interval. Treacher

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[1] Read at meeting of American Ophthalmological Society, 1920.

[2] *Archiv. f. Augenheilkunde*, vol. xi., p. 413.

[3] *Graefe's Archiv.*, vol. xxxiii., No. 2, p. 47.

Collins[1] observed a case with an interval of three years. In the discussion of this case Lawford,[2] referred to a case in which a growth was observed in the second eye of a child whose eye was removed for glioma two years previously. Enucleation was refused, vision gradually deteriorated, and three years later the eye was hard, blind, and a yellow reflex was noted. The slowness (3 years) of the growth in the second eye is of interest.

In the case which furnishes the subject of this paper the interval of time before the involvement of the second eye became noticeable was four and one-half years.

Maghy[3] reported a case of bilateral glioma of the retina in which the second eye became affected thirteen years after the first. The first eye was removed for glioma in 1900, the patient being then two. In 1913 vision began to fail in the remaining eye, thirteen years after the enucleation of the first eye. The diagnosis was obscure and treatment was without avail. The eye was finally excised because of pain in 1918. Microscopically glioma retinæ was found present.

Glioma always undergoes regressive changes, ending in necrosis with fatty and calcareous degeneration of the necrotic tissue. The necrotic parts are the opaque white dots and streaks, while the young tissue is gray or grayish pink and translucent. The fatty parts soften into an amorphous fluid, with granules (calcification), hyperæmia of the vessels and hemorrhages.

Retrogressive changes with preservation of sight. Retrogressive changes may occur in eyes which still can see, and a spontaneous recovery of retinal glioma is possible. Glioma of the retina particularly when affecting the second eye may show a varying degree of malignancy.

Meller[4] reported on a case of true glioma retinæ in a second eye in which there was no progress in the tumor growth for five years, and in fact in the latter part definite signs of retrogression were present. This eye in 1910, presented a yellowish mass about 6 P. D. below the disk and extended, several P. D.

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[1] *T.O.S.*, 1896, vol. xvi., p. 142.

[2] *T.O.S.*, 1896, vol. xvi., p. 148.

[3] *British Journal of Ophthalmology*, Aug., 1919.

[4] *Centralblatt f. Prakt. Augenhlk.*, vol. xxxvii., 9, 101.

broad, to the periphery for about 3 P. D. This mass projected into the vitreous with several tortuous and dilated vessels. A second yellowish white mass was present beyond. A third growth appeared in the extreme outer periphery. The disk was peculiar in that the vessels downward were thickened and tortuous. These masses somewhat enlarged in 1911, remained stationary in 1912, and the case was not seen again until 1915 when the vision was found to be normal, disk and vessels normal; the tumor mass was still present but flattened resembling choroidal atrophic areas except that it contained white calcareous-like masses. The smaller mass contained these white areas surrounded by a dark gray pigmented zone. The many thick and tortuous vessels on these masses had disappeared. The enucleated eye showed a typical glioma retinæ.

Purtscher[1] speaks of two members of a glioma family, one a boy of 5 and a woman of 29, who presented a peculiar picture of choroidal changes which was regarded at the Fuchs Clinic as undoubtedly retrogressive glioma.

Siegrist[2] reported with ophthalmoscopic drawing a retrogressive glioma in the second affected eye of a child of three and one-half where a grayish area occupied the macular region with a prominent white, glistening central lobular mass. Seven years later,[3] the white mass above and to the outer side of the macula was the same, and the individual figures were somewhat more sharply defined. The disk and the macula seemed perfectly normal. In the periphery, up and in, there still remained a diffuse, greenish, white area. The vision was $\frac{6}{6}$.

The ophthalmoscopic picture in these cases in regressive glioma is quite unusual. The changes usually occur about the optic nerve and macula at the posterior pole and consist in irregular choroidal atrophic areas with flat detachment of the retina by peculiar whitish masses and abnormal vessels.

Much more frequent is complete necrosis of the gliomatous tumor and shrinkage of the eye.

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[1] *C. f. P. A.*, vol. xxxix., p. 198.

[2] *Bericht d. Ophth. Gesell. Heidelberg*, p. 355, 1912.

[3] *Bericht. d. Ophth. Gesellsch.*, p. 317, 1919.

Retrogressive changes with shrinkage of eyeball, rarely with preservation of life. Temporary retrogression in glioma has been frequently observed; generally growth sets in again and progresses, leading to perforation of the eyeball and death.

Occasionally the eye affected with glioma shrinks; according to Leber, the shrinkage is not due to the regression of the glioma but is caused by an intermediary plastic uveitis which then ends in phthisis bulbi. The cases in which this occurs and no living glioma cells remain are unusual.

Parsons[1] reported on a case of glioma retinæ in a shrunken globe. The shrunken eyeball contained necrotic cells resembling cells in the degenerate parts of glioma. The blindness of the eye dates from an attack of measles at the age of eight months, or eighteen months before the child came under observation. He succeeded in collecting fourteen cases of glioma retinæ associated with shrunken globe. In ten of these the other eye was the seat of the glioma. The shrinking occurred after perforation, the result of extra-ocular extension of the growth, and in others, inflammatory symptoms preceded the phthisis bulbi.

Berrisford[2] found 20 cases of gliomata in shrunken eyes recorded in literature and published one case.

O'Connor[3] reported a case of glioma and phthisis bulbi in the first eye and glioma with orbital extension in the second eye. Verhoeff who made the microscopic examination of the first eye regards the glioma as primary and the phthisis bulbi as following an inflammatory reaction about the necrotic tumor.

Knieper[4] reported on a case where shrinkage of an eye following glioma retinæ was under observation for a period of eleven years. This author has collected all previous publications of phthisis bulbi in retinal glioma. Her own case was that of a bilateral glioma in whom one eye was enucleated and removal of the second eye was not permitted. Eleven years later the child was accidentally found in a blind asylum and a very small phthisical eyeball discovered. In the meanwhile, the eye had first enlarged, then suddenly perforated and collapsed. Knieper reviewed twenty-two cases found in the literature and found in the majority that the observation period of the shrinkage was too short, and in these the possibility of a subsequent growth could not be excluded. Wadsworth's observation is quoted in this connection where after phthisis bulbi had existed for 20 months glioma again progressed.

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[1] *O. H. R.*, vol. xvi., p. 141.

[2] *O. H. R.*, vol. xx., p. 11.

[3] ARCH. OPHTH., p. 312, 1917.

[4] *Graefe's Archiv.*, vol. lxxviii., p. 310.

deKleijn[1] observed a case of bilateral glioma in whom the secondarily affected eye without inflammation gradually became smaller and blind. The eye was removed and contained calcareous and bony tissue and gliomatous material.

Lindenfeld[2] reported on a case of a child, four years old, with glioma in the right eye and atrophy of the left eye. The left eye at first became enlarged, red, and painful. This was abruptly followed by shrinking of the eye and pain ceased, and the eye remained small for two years without any change. The right eye enlarged and extraorbital growth occurred. Both eyes were enucleated and the shrunken eyeball showed a connective tissue mass with calcareous deposits, bone formation and no traces of living glioma cells. This case shows "spontaneous cure" by complete necrosis of the tumor and shrinkage of the eye.

The *history of the case* which is the subject of this paper is as follows:

W. D., aged 6½ years was seen on April 28, 1919, with a history that at the age of two the left eye was removed for glioma by Dr. George W. Swift of Seattle, November 4, 1914. About four months ago the sight in the good eye seemed to be defective, and a diagnosis of glioma was made by Dr. Swift.

The boy is well nourished, fully developed, and has apparently enjoyed good health excepting at the age of six months there was some fever while teething. He has never suffered from enlarged glands.

Examination showed absence of the left eye. The orbital cavity was normal.

Right eye: Vision $\frac{6}{12}$. The anterior segment of the eye was normal. Tension normal.

After dilating the pupil a few vitreous opacities were found present. The disk could not be made out, being hidden by a round subretinal mass directly above and the retinal vessels passed forward over the swelling. The mass was distinctly pink with several round, white areas. Its elevation was 6 D. Below this there was a whitish area like organized tissue which projected into the vitreous. Vessels ran along its sides, and as it extended down it broke up in two directions, one temporarily to join a series of retinal hemorrhages, and the other nasally was prolonged into a number of intensely white, rounded, vitreous bodies, directly continuous with a large white mass which occupied the extreme nasal periphery of the eye ground. This extended as far upward as can be followed. It was of an intensely white, fluffy appearance without detail, except at its upper margin where there was another pink subretinal mass surrounded by a number of hemorrhages. The ophthalmoscopic picture was regarded as typical of glioma, particularly on account of the large white vitreous bodies.

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[1] *Graefe's Archiv.*, vol. lxxx., p. 371.

[2] *Graefe's Archiv.*, vol. lxxxvi., p. 141.

The boy was taken into the hospital and as there was no fever a general tuberculin test was instituted without any reaction either local or general.

During this period the changes in the eye ground showed distinct progress, and on May 13th the vision was reduced to $\frac{6}{18}$. There were more vitreous bodies. The subretinal mass which was regarded as active, seemed distinctly enlarged and to have become more distended.

It was decided to immediately begin treatment with radium, and at the General Memorial Hospital under the direction of Dr. H. H. Janeway and Dr. Douglas Quick on May 12th an application of radium was made: 414*mc* of radium filtered by 2*mm* of lead and ½*mm* of silver was applied for 5 hours at a distance of 2*cm* from the skin over the right temple.

May 23d: Vision $\frac{6}{24}$. The pink mass was much clearer. There was perhaps more blurring in the part below.

May 31st: Vision the same. The pink mass continued to clear up. The skin of the eyelids showed some reaction from the treatment.

June 10th: Decidedly clearer. The hemorrhages in the vitreous and the glioma flocculi have disappeared. There were still some vitreous opacities, but they were less dense.

The improvement kept up for nearly six weeks, then on June 23d, the active and pink area directly above the disk again enlarged and became swollen. Its upper margin was more blurred. Another treatment of radium was decided upon: 168*mc* with the same filtration at a distance of 2½*cm* was applied for 15 hours.

July 18th: Vision $\frac{6}{60}$. The general appearance was quite changed. The picture was very muddy, and the vitreous appeared stirred up. The white patches have gone; the pink area was less swollen. There seemed to be a number of fresh hemorrhages, and a possibly new detachment directly down.

July 28th: The pink mass to-day was distinctly yellow. The vitreous blurr continued and some degenerated gliomatous masses were present. The large mass in the nasal periphery showed some fresh hemorrhages and cholesterin deposits.

July 31st a third radium application was made: 1312*mc* with the same filtration but covering a larger area was applied at the side of the orbit at a distance of 3*cm* for 2½ hours.

October 6th: Vision $\frac{2}{60}$. General condition good. The pink area was distinctly enlarged. It was now white and there were no pink areas to be seen.

October 6, 1919, fourth radium treatment: 1227*mc* in a smaller type of container but with the same filtration, at a distance of 3*cm* was applied at the side of the orbit for 2 hours.

October 21st: The last treatment was followed by a very distinct failing of vision. The mass had manifestly enlarged being seen with a plus 8 D. It occupied the center extending down and nasally. The fundus was very much more blurred and the details were difficult to decipher.

November 4th: The mother reported that his sight was at first very poor but has perhaps recently improved — $\frac{1}{60}$. The grayish mass occupied the center extending down. The nasal periphery was muddy. There were no fresh hemorrhages. The mass appeared gray and white with definite degenerative areas. Vitreous opacities as before.

As Dr. Janeway did not advise any further treatment with radium the boy returned to his home in the West.

A letter from his mother received December 20th stated that his sight was very much worse. He cannot see the fingers at any distance. In the opinion of the mother while the sight had usually improved with each radium treatment, it failed to do so after the last.

In a letter recently received the mother stated that the sight was entirely lost and the eye was subsequently enucleated.

The Early Ophthalmoscopic Signs of Glioma Retinæ.

The early ophthalmoscopic symptoms of glioma retinæ are not fully described. Now that the importance has been brought out of examining the second eye with dilated pupil and in narcosis if necessary, our knowledge of the early stages should be amplified. In those descriptions that are on record there was found in the retinæ a sharply-defined, opaque, grayish white area, which is distinctly prominent and sometimes constricted at its base. The surface may present several flat depressions. Its form is round or oval; its size varies from ½ to 4 P. D. It arises at the disk or in the region of the macula, or at some distance away. Sometimes there are two distinct tumors. One author observed at the posterior pole a number of white nodular elevations surrounded by pigment. A larger mass has been observed surrounded by a number of small nodes. Vessels continue over the tumor, branch and disappear in its substance, then again to reappear. In other cases there are no sharply defined tumors, though there is a general prominence suggestive of a beginning detachment of the retina. Even in these early stages the cases show a tendency to divide into two groups, as a detachment of the retina is present or absent. If there is no detachment, a white glistening, nodular or clefted mass is seen, or more anterior there is a pale white flat reflex or tumor mass. The vitreous contains white flocculent bodies of various size which slowly float and represent miliary tumor-nodules;—these are very prone to absorb or to degenerate. The process apparently can be either in front or back of the retina. There is a distinct difference in the appearance as the growth retrogresses or advances. In the latter stage it is pink, while in the former it is white. Hemorrhages are not infrequent.

In the case just described the opthalmoscopic changes can be divided into those which are subretinal, rounded in outline, and pink in color denoting activity in growth. The other changes are in front of the retina and include the retina itself; these are white, like organized retinal connective-tissue, with organized whitish masses and intensely white areas, necrotic in character. The vessels do not show any particular variation. Hemorrhages occur both in the retina and in the vitreous. A very striking and characteristic picture are the intensely white gliomatous flocculi in the vitreous. The ophthalmoscopic picture is characteristic and quite different from those seen in tuberculous retinitis and exudative retinitis.

RESULTS OF RADIUM TREATMENT.

A number of cases of glioma retinæ have been treated with radium. The first and perhaps the best known because the treatment seemed successful at first, is the case which Axenfeld[1] reported two years ago. The case was treated with X-rays, and had been under observation for two and one-quarter years. The three nodules were reduced to small spots. At first no other change occurred in the eye. Then a cataract developed which was successfully operated upon, with restoration of vision. A discission was done a half year later. The gap in the membrane contained numerous white flocculi in the vitreous body. A detachment of the retina then developed; a partial detachment in the region of the macula had occurred during the process of the treatment. The present detachment, however, extended, and it was not until some time later that the child came back with a large perforating ulcer of the cornea, prolapse of iris, and the eye was enucleated.[2] On examination, a relapse of the glioma was found particularly in the retina, in the form of small groups of cells. These cells showed a uniform sarcomatous character as is seen in choroidal and orbital extension.

Axenfeld cautions that the prognosis should be guarded, and that a number of years must elapse before a final decision can be given.

A number of cases treated with radium have been reported in this country. Dr. H. H. Janeway[3] at the General Memorial Hospital has treated six, of which only one (Schoenberg's case) has done well. Schoenberg's case[4] was that of a child of 5 whose second eye was treated by radium and X-ray, with recession and arrest of the tumor and preservation of good vision during a period of observation now of three years. An opacity at the posterior pole of the lens developed in the course of the radium treatment. About the regressive gliomatous tumor a ring of chorio-retinitis developed which Schoenberg suggests as resulting from the radium therapy. Similar changes have, however, been observed in cases of spontaneous regressive changes (Meller's case).

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[1] *Kl. Monatsbl. f. Augenhl.*, vol. lii. and liv.

[2] *Axenfeld, Deutsch. Ophth. Gesellsch.*, Heidelberg, 1919.

[3] ARCH. OPHTH., p. 163, 1920.

[4] ARCH. OPHTH., p. 485, 1919.

The authorities are in accord in regarding the structure of gliomatous tumors as being particularly susceptible to radioactivity. On the other hand experience has shown that the best results in the treatment of cancer are obtained by the use of a single large dose. In the case described in this paper distinct improvement followed the first treatment. Our ill success in glioma seems to be due to the fact that not a large enough dose of radium was given to kill off the gliomatous tissue. The associated injury to other tissue of the eye (cataract) is negligible. In judging the results with radium the varying malignancy of glioma must not be forgotten and a certain, if not extremely rare, possibility of spontaneous retrogression.

NASO-LACRIMAL SURGERY IN OPHTHALMOLOGICAL PERSPECTIVE.[1]

By Dr. CLIFFORD B. WALKER, Springfield, Mass.

(*With three illustrations on Text-Plate XX.*)

IN the last decade, considerable progress has been made in the surgery of the lacrimal apparatus, especially in the development of naso-lacrimal fistula operations, but it is still questionable whether as much advance has been attained as is possible because of the fact that the region which needs the most study happens to lie in the plane of cleavage, as it were, between the domain of the ophthalmologist and the rhinologist. Thus the region corresponds in a way to no man's land, as far as naso-lacrimal fistula is concerned.

Furthermore, other factors are also active in preventing fruition of the fullest possible knowledge of the ultimate possibilities of naso-lacrimal fistula. For instance, the patient almost invariably presents himself to the ophthalmologist, since the visible manifestations of the condition are almost entirely ocular, but the ophthalmologist is reluctant to exploit procedures that lead him into a strange field, and as a rule, the patient is reluctant to pass out of the hands of the ophthalmologist for treatment. This feeling may be mutual. The rhinologist while he is more prone to consider and perform naso-lacrimal fistula operations, may not be familiar with the passage of probes in the lacrimal apparatus, and since he does not have many cases to deal with perhaps in this connection, does not advance his knowledge and technic with the same persistence that he does in other portions of his field.

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[1] Read at meeting of American Ophthalmological Society, June, 1920.

And thus, from a statistical standpoint the exact possibilities of the operation remain to be seen. Certainly at the present time it is usually possible to get a sharp argument from ophthalmologists as to whether naso-lacrimal fistula operation has any advantage whatever over extirpation of the sac, in fact it seems to me that the majority of ophthalmologists contend that since extirpation of the sac cures such a high percentage of cases, or makes them so comfortable, that there is no use in considering any other operation. I remember a similar plea for iridectomy, as against the trephine operation for glaucoma, at the time this operation was introduced by Elliot, but at this point the analogy cannot be carried farther since after the visit of Elliot to this country there was a flood of test operations that gave us very substantial data on which to make comparisons, while following the introduction by West, of the possibilities of naso-lacrimal fistula some ten years ago, the report of test cases has been comparatively meager.

The variety of operations that have been suggested is a testimonial that we are still in the formative stage as far as the ideal procedure is concerned. Yet even now the data, slow as they have been in accumulating, are sufficiently crystallized to indicate that eventually a naso-lacrimal fistula procedure will become the operation of election, for a definite group of cases, and set aside the great many lacrimal-sac extirpations. I expect this result to be brought about more by the demand of human nature than by any other single factor, for I have yet to see the patient who would permit an external incision to be made, with its scarifying possibilities, if the same result could be obtained without an external incision, provided only that the patient may be assured that the procedure will be painless; and this assurance can be given. Unquestionably we have all seen patients suffering with chronic dacryocystitis who have undergone a variety of local treatments and even a most painful series of probing unsuccessfully, and even after ten or fifteen years still unwilling to permit an external lacrimal sac extirpation. Yet these very patients may be delighted indeed to have the naso-lacrimal fistula operation done as soon as they are assured that it will not require ether, and can be done without pain.

While this factor may readily be the predominant element in turning the tide it is not clear to me that there is not some sophistry prevalent concerning the mechanism of improvement with sac extirpation, particularly concerning some magic or trophic influence of the lacrimal sac over the secretory lacrimal mechanism. In fact I believe as the possibilities of naso-lacrimal fistula operation are developed it will prove that only in rare instances will the results of sac extirpation be superior in subsequent functional result to that of the successful naso-lacrimal fistula, but first we shall have to find by experience just what conditions contraindicate the fistula operation.

The principle of fistulization is no different here than in other regions of the head. The natural tendency is for a fistula to close, unless it is kept open by a continuous pressure of fluid, an abnormal growth of cells, by plastic reconstruction, or by a gap in the tissues too great to be bridged by proliferation or granulations. In the case of the naso-lacrimal fistula we are aided to some extent by the pressure of drainage through it, but principally we must depend on making the largest possible opening or by a plastic-flap operation, but plastic-flap operation involves an external incision to be at all reliable, and therefore will doubtless be abandoned.

The ability of a fistula to resist closure is usually measured by its narrowest diameter. The shortest diameter in the naso-lacrimal fistula is more or less equal to the diameter of the sac and its bony canal antero-posteriorly. Vertically a much greater diameter may be obtained, but it will not prevent closure if the antero-posterior diameter of the opening is left too short, and there is a tendency for this to occur in the nasal operation because of the anatomical relation; the direction of approach being such that it is much easier to get a sort of oval opening with the long diameter parallel to the canal. This difficulty accounts for some of the failures in this technic and of course it should be carefully avoided. The best way that I have found to avoid this narrowing tendency of the antero-posterior diameter is to use a burr, Fig. C, on the bony opening, thereby obtaining a smooth round opening of sufficient diameter. The burr is spherical in shape and seven millimeters in diameter and may be either hand- or motor-driven. It may be used with or without a guard.

Although the desire and attempt to produce a naso-lacrimal fistula extends back almost as far as the history of medicine, it cannot be said that any material progress was made until the work of Toti. Before his time efforts had been mostly directed towards punch opening from the sac into the nose, or the dilation by means of probes and subsequent use of stylets. As is often the case in developmental work, the original operation is, not uncommonly, too elaborate, and it was not long before Halle, West, and others showed that an external incision was not absolutely necessary nor were the plastic procedures of Toti necessary for the successful maintenance of a fistula in a high percentage of cases. And it still remains to be proven whether plastic operation has any material advantage over the simple, circular opening of maximum diameter.

To the knowledge that a fistula opening could be maintained Halle added the valuable technical trick of forcing the nasally exposed surface of the sac far enough into the nose, by means of a probe passed through the uncut punctum, so that a round window could be comfortably cut in this side of the sac to correspond to its largest possible diameter. Add to these important steps the knowledge that a very perfect anæsthesia may be obtained without toxic manifestations by applying a small amount of cocaine mud to the nasal wall opposite the sphenopalatine ganglion at the posterior tip of the middle turbinate, and another small portion to the nasal wall, at the anterior extremity of the cribriform plate, and the field is open for an accumulation of facts concerning the possibilities of this operative procedure.

At the time Toti was doing his work and immediately thereafter we find report of operations showing forty to fifty per cent. perfect results and fifteen to twenty per cent. showing improvement. As time goes on the percentage of favorable results improves, and the percentage of failures decreases, until among recent reports, Patterson, Fraser, Wiener, Sauer, and others, we find eighty per cent. of perfect results and only ten or twelve per cent. of failures, with other cases no better or no worse than the ordinary sac operation, and it does not seem unreasonable to hope that as more reports are submitted and more careful studies made of failures, that very much better percentages may be obtained as we become able to make more accurate and satisfactory selection of cases.

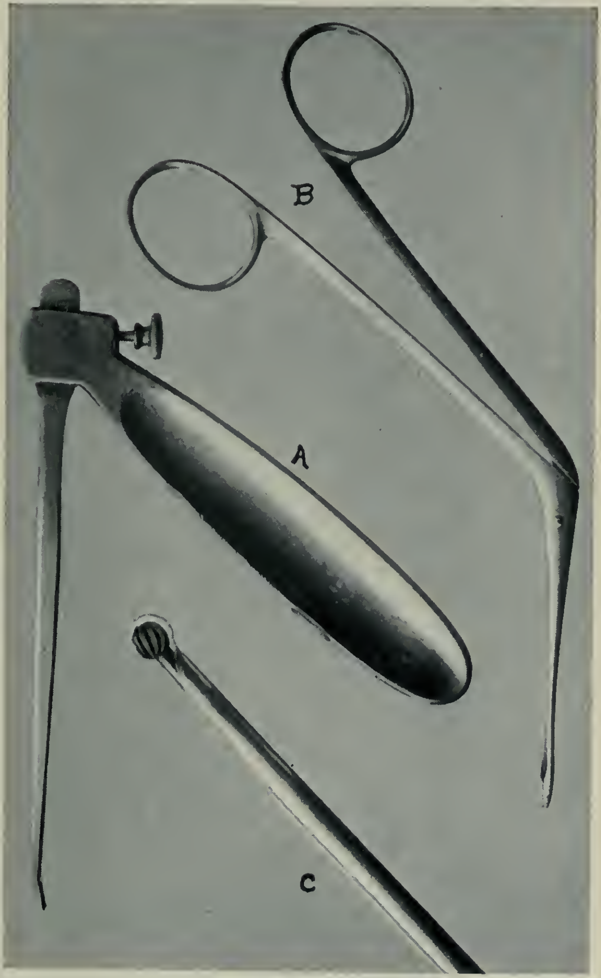
The cases of dacryocystitis naturally fall into two groups, acute and chronic. My first cases were limited to the acute type and were handled in a purely ophthalmological manner. They were all the ordinary phlegmontype, with the eye almost closed, and the swelling most marked in the region of the inner canthus. Since an external incision was deemed necessary because of the extent of the phlegmon it was made as for a sac extirpation but it was determined to exploit the possibilities of the internasal drainage of the abscess by the fistulization process. Hugging the nasal side carefully the dissection was carried down between the sac and its nasal wall; a very narrow mastoid gouge or chisel was then used to make the initial opening through the nasal wall as far anteriorly as possible. The chisel tip may be easily seen as it enters the nasal cavity directly in front of the middle turbinate. There is no important structure to be injured by the chisel as it is pushed horizontally inward. The agar nasi cell may be well-developed and overlie the sac so that it has to be traversed by the chisel, but nevertheless the opening is enlarged sufficiently to allow the entrance of a sphenoidal or a Kerrison punch. A burr may also be used. The bony opening is then enlarged in all directions to correspond to the maximum horizontal diameter of the canal. Without doubt a much more accurate and satisfactory opening can be obtained in this way than it can by means of the internasal work.

In most of these acute cases some pus is apt to be found in the agar nasi cell, or in the anterior ethmoid cells, at the time the nasal opening is made. After the nasal opening is made the punctum is dilated and a probe passed into the sac, and that portion of the sac is located which corresponds to the central portion of the bony opening already made. If the sac has ruptured of course a good deal of pus will have been encountered and drained before the sac is opened, and still more pus is evacuated from the sac when the window is taken off, which corresponds with the bony opening. A good-sized probe should now pass freely from the punctum through the sac and into the nose. In order to maintain these openings and insure drainage, as well as satisfactory apposition of layers, a small gutta-puercha (protective) cigarette drain of satisfactory size was pushed through the nasal opening and made to extend an inch or so into the cavity. The other end of the cigarette drain was split and rolled into two small balls, one of which was tucked into the dome of the lacrimal sac, and the other portion pushed downward into the canal. The external wound was then closed and no further dressing made. In four or five days the cigarette drain was pulled forward through the lower nares and the patient was watched for several weeks to see that granulations did not close the fistula. It happened that in none of these cases was there any marked catarrhal condition of the nose and the opening showed no tendency to close. I can recommend this method also for chronic cases where an external incision will be permitted.

Reports as long as two years in duration show that these cases have been in good condition without recurrence since. The chronic group of cases which I have operated upon includes conditions varying from six months' to twenty years' duration. The method used embodies the fundamental principles as laid down by Halle of uncapping the lacrimal sac immediately in front of the anterior attachment of the middle turbinate, then pushing the sac into the nasal chamber by means of a probe pushed through the uncut punctum, and excising much of the tent, thus produced, as can be obtained.

Certain difficulty encountered in accomplishing these maneuvers and the instruments used may be here described. One of the first difficulties that I encountered was in getting a chisel to bite into the bone at the proper distance in front of the middle turbinate; it is a good time here to make the chisel slip into the upper prolongation of the maxillary bone, and yet in many cases the chisel comes so nearly parallel to the bone that it slips off readily. Accordingly I had a chisel, Fig. A, hollow ground on the back and beveled to about the curve of a finger nail so that it would readily bite into the bone even if it was held very nearly parallel to the bone. A handle was then devised so that it could be held with the hand braced against the cheek in such a manner that the chisel was held in proper position and at the same time prevented from overacting or going too deeply. The removal of the bony window is very easy with this chisel but it is still easier with the burr shown in

ILLUSTRATING DR. WALKER'S ARTICLE ON "NASO-LACRIMAL SURGERY IN OPHTHALMOLOGICAL PERSPECTIVE."



A. Reversible handled chisel used to uncap bony wall of lacrimal sac.

B. Modified Hartman forceps used to grasp sac only while tented by probe.

C. Burr with guard.

the illustration which has a guard to prevent injury to the nasal septum. However, all hospitals do not have the necessary motor for driving such an instrument, so that it is advisable to have a chisel also, but when the sac is already exposed the opening can be very easily enlarged with the burr, even used in the hand without a motor.

At this stage it is easy enough to tent the sac into the nares, but it is sometimes difficult to get a good-sized hold of it, in order to excise the window, since the instrument with which the sac is grasped is so apt to include also the probe, and each time the probe is withdrawn the grasp on the sac either lost or weakened. A few serrations were filed out of the grasping portion of an ordinary Hartman forceps, Fig. B, so that a No. 1 or 2 Bowman probe could just barely pass through this interstice without being held when the forceps was closed. Now when the probe is in the sac the tented portion is grasped including the probe; there is no difficulty experienced in removing the probe from the grasp of the forceps, and leaving the sac without disturbing the hold on the sac itself. However, this grasp on the sac may be still further improved by inserting another forcep and grasping the sac still closer to the ocular side. To cut out the window of the sac thus held I have used an ordinary cataract knife satisfactorily, though without a doubt a small blade curved on the flap, about one-half inch long, would be the most satisfactory. After cutting out as much of a window as is possible in this manner it is often possible by working the probe around to tent a part of the lip on one edge or the other and remove by the same steps still more of the lateral margin of the window.

In the chronic group of relatively short duration, six months to two or three years, and with very little nasal catarrh the results obtained are practically perfect. The sac wall is not hypertrophied or thickened and the healing process is almost as prompt and satisfactory as that obtained in acute cases, but the most interesting cases and those demanding the most study are of long duration, ten to twenty years, and have often been through many previous procedures without relief. Chronic catarrh is apt to complicate these cases and chronic or subacute ethmoiditis and catarrhal deafness may also be present. It is in this group I think that failures are more likely to occur, but perhaps with further study we may be able to determine just which cases are very apt to fail, and avoid operating upon them internasally. Two cases in this group it would seem profitable to discuss in more detail.

Mrs. J. B. C., age 52, has had chronic nasopharyngeal catarrh for the last twenty-five years, during the last twenty years her hearing has progressively failed until at present she can only hear the loud spoken voice. For the last twenty years she has had chronic dacryocystitis on the left but no trouble with the right eye. She has been treated extensively by many physicians but no improvement has been made. For the sac condition innumerable probings and irrigations have been carried out, and one difficult operation under ether, probably a probing and the placing of a style, resulting in a very severe reaction which did not quiet down for several weeks. For the last ten years the eye has been slightly reddened under irritating influences of the chronic discharge from the sac and constant wiping of the eye. At present the eye is decidedly inflamed and pus can be readily expressed from sac.

On preliminary treatment March 22, 1920, a large quanity of pus was irrigated from the sac through the lower punctum, but it was impossible to force any fluid into the nose, though a probe could be readily carried to the nasal wall of the sac. On March 26, 1920, she was operated on in the manner described internasally, and apparently a very satisfactory opening was obtained. As is usual in these cases the first night was very painful, and there was a moderate amount of bleeding (I have not found it necessary to use packing), but the next day she was comfortable. On the second day no difference in appearance could be seen in the two eyes, and the patient was overjoyed at the result of the operation. She lived a considerable distance out of town, however, and it was difficult indeed for her to come in for follow-up treatment. Fluids passed readily and there was no indication of difficulty until on April 24, 1920, it was noticed that granulations were not subsiding rapidly enough in the neighborhood of the operation, and there was more resistance to fluid syringed from the punctum into the nose through the opening. Trichloracetic acid, and strong silver-nitrate solutions were used to reduce granulations, but on May 13, 1920, it was noted that the granulations had a very firm and proliferating tendency. A bunch formed about the opening very similar to a keloid in appearance. Fluid can still be forced into the nose, but a probe will pass with difficulty there is evidently sufficient drainage so that the patient experiences no difficulty. The eye is still without inflammation or epiphora.

While from the patient's standpoint this operation is still a success it seems to me that it must eventually turn out to be a failure, though I expect to attempt another operation, but the manner in which these chronic catarrhal membranes form scar tissue of elevated character, much as one sees in keloid on the skin, seems to put this case in an entirely different classification from the others I have operated upon. It is possible that the antero-posterior measurement of the opening was not as wide as possible, and on this I shall attempt another operation. On the other hand, the proliferating characteristics of the scar tissue granulation formation after the operation suggest that it may be able to bridge any opening of width that is possible. If this case turns out to be a failure it will be the only one that has occurred in a group of ten so far. To observe the formation of scar tissue and granulations in detail the small nasopharyngoscope with corrected image is very satisfactory indeed.

The following case is very similar in many respects, except that the tendency to exaggerated granulations and scar tissue formation has not been noticed with the nasopharyngoscope at all.

Mr. E. B., age 60, presented himself on March 27, 1920, for catarrhal treatment. He had chronic dacryocystitis of the right eye, of twenty years' duration, and had been through many operations and probings of the most painful type. The canaliculus of this eye had been slit and stylets had been inserted, but all to no avail. The left eye had been bothering the same way for the last two or three years increasingly. Deafness of catarrhal nature had also been approaching for the last ten years, but had not become much of a handicap until the last five years. Now he can only hear the loud spoken voice. He is constantly wiping his eyes all day long in order to see clearly. Pus was syringed in copious quanities out of both sacs but no fluid could be made to pass through into the nose. The lacrimal probe could be readily passed to the nasal wall of the sac on both sides.

On April 25, 1920, the naso-lacrimal fistula operation was done internasally on the left side, and a well-defined ethmoiditis of the anterior cells was drained at the same time. The operative area has healed kindly with no marked tendency to hypergranulate, and the eye has been clear since the day after the operation. A silver nitrate bead was used to cauterize the few granulations that were active May 6, 1920.

May 6, 1920, the naso-lacrimal fistula operation was done on the right side internasally, here also a mild ethmoiditis was drained, and the sac itself was found to be markedly hypertrophied, the walls being about one-eighth inch in thickness. However, the granulating tendencies were not present here, as seen in the previous case, and so far the opening has maintained itself in excellent condition. A chromic acid bead has been used to cauterize the margin of the wound on this side.

It may be worth while in passing to mention here a trick in cauterizing the wound margin for granulating conditions in these cases. A fine wire such as one may get with syringe needles was bent to form a narrow figure of eight, five millimeters in length, on the central portion of this, a little bead of molten silver nitrate or chromic acid was dropped and formed symetrically, leaving a loop of wire projecting at either end. A silk thread was then passed through these wire loops and knotted, so that the bead could not slip along the course of the thread. About eight inches of thread extended from one loop and ten inches from the other, with the bead centrally situated. The long end of the thread was passed through the eye of a slender needle and the eye of the needle carrying the thread was passed through the punctum in the same manner as a probe would be passed, as far as the septum, and then slightly withdrawn so that the loop of thread was readily caught on a small hook, and the needle was withdrawn from the punctum. This left a loop of the long end of the thread in the nose. This loop of thread was then gradually worked down until it projected from the lower nares. The other or short end of thread was passed through this loop. The loop was then drawn upward through the punctum dragging with it the short end which was finally left protruding alone through the punctum. Then by drawing this end through the punctum, the bead is drawn into the nose and accurately to the margins of the wound from the nasal side.

In the presence of swelling, and with the septum very close to the operative wound, the operative channel can be better cauterized by using the bead this way than when the bead is simply annealed on to the end of a bent wire and applied at the margin of the wound. The bead is made to travel up the blade of a nasal speculum, so that it does not unnecessarily cauterize neighboring parts of the nose.

Comment. From an observation of the process of healing as seen through the small nasopharyngoscope, it does not seem clear that the flap operation would necessarily add much toward the preservation of a fistula in these cases, in the first place because it is almost impossible to arrange flap properly in this awkward area, and in the second place the tremendous amount of swelling and the process of sloughing, which takes place immediately after the operation, because of the fact that it is not an aseptic operation, would without doubt tear all sutures from their anchorage and allow flaps to be displaced. Statistics also bear this view out because the proportion of failures is no less where plastic work has been done. In fact it is just as easy to assume that the operation is successful in spite of the flap and to assume that it is successful because of the flap. From an ophthalmological standpoint, of course, this observation is interesting and valuable because it makes the operation as feasible through an external incision as it does through an internal incision, since the only important point is an opening of sufficient size that it will not be bridged by granulation tissue in the group of cases where success in the operation may be expected. Doubtless in the group of cases in which the operation will not be successful flaps will be of no avail anyway, and we must simply learn to exclude those cases from the fistula operative procedure and resort to lacrimal sac extirpation.

While at present it seems possible that ten per cent. of failures may be expected from the naso-lacrimal fistula operation as far as we can prove from our present data, still it seems possible to me that if the ophthalmologist would take hold of this operation more frequently there would be other advantages derived besides development of the ability to eliminate the unfavorable cases and reduce the ten per cent. of failures to practically nil. One of the first advantages would be to conserve a familiarity with the orbital wall of the nose and this familiarity would undoubtedly be helpful in other instances. Thus, only a short time ago, I saw a patient who had been repeatedly fitted for glasses in the last six months, by various men, for the relief of a peculiar discomfort between the eyes. His vision was excellent with all of his glasses and on looking into his nose it was obvious that his difficulty was due to sinus trouble since good-sized polyps were visible in the upper part of his nose. In the field of perimetry also a nasal examination may be helpful, for instance. I have seen pus about the middle turbinate to be decidedly important in the diagnosis between certain cases of glaucoma and ethmoidal sinusitis, or even a hypophyseal dystrophy where the visual defect was inclined to be sclomatous in character or more or less referred to the temporal portion of the field. This attitude does not necessitate that the ophthalmologist become a rhinologist, because he looks in the nose, any more than it seems that a rhinologist becomes an ophthalmologist because he looks in the eye, in fact I believe there are more rhinologists who are familiar with the use of the ophthalmoscope than there are ophthalmologists who are willing to use the nasal speculum and the head mirror.

CYCLOPIA, ITS BEARING UPON CERTAIN PROBLEMS OF TERATOGENESIS AND OF NORMAL EMBRYOLOGY; WITH A DESCRIPTION OF A CYCLOCEPHALIC MONSTER.[1]

By Dr. EMORY HILL, Richmond, Va.

(*With three illustrations on Text-Plate XXI.*)

I. Introduction.

This paper attempts (1) to present the newer conceptions of cyclopia which are not found in the literature of ophthalmology, and (2) to discuss certain questions of embryology suggested by the study of cyclopean eyes.

II. Historic Résumé.

Mythology; supernatural causation of monsters; natural causation of monsters; the theory of hybridity; the theory of maternal impressions; early experimental teratogenesis.

III. Modern Theories of Teratogenesis.
  1. The Germinal Theory.
  2. The Non-Germinal Theories.
    a. The Mechanical Theory.
    b. The Pathologic Theory.
    c. The Embryologic Theory.

IV. The Eye in Cyclopia.

V. Other Deformities Associated with Cyclopia.

VI. The Mechanism of Cyclopia.

VII. Description of the Author's Specimen.

VIII. Modern Experimental Teratogenesis.

Stockard's experiments with fish embryos.

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[1] Candidate's Thesis, American Ophthalmological Society, 1920.

IX. The Classification of Cyclopia.
    Adami's growing-point hypothesis.
X. Problems of Normal Embryology.
    1. The Position of the Optic Anlage.
    2. The Origin of the Optic Nerve.
    3. The Self-differentiation of the Crystalline Lens.
XI. Conclusions.

I. INTRODUCTION.

Ophthalmic literature contains many references to cyclopean eyes and some rather comprehensive monographs treating of various phases of the subject of monstrous formation of the head end of the embryo. The most modern of these contributions, which are more than mere case reports, accept the observations of Dareste, and the later and exceedingly important investigations which go to disprove the earlier theories of the causation of cyclopia have not found their way into the literature of ophthalmology.

Camille Dareste (20), in his monumental work on the artificial production of monstrosities, concluded that cyclopia is the result of a premature closure of the anterior end of the neural tube, though he confessed his inability to explain why this premature closure should take place. His conclusions were recorded in full in the *Annales d'Oculistique* (19) in 1891. The life-long work of this devoted scientist stands as the high-water mark of experimental teratology at that time. Numerous later authors close their contributions with a review of Dareste's conclusions as the last word on the subject. Ballantyne (9), whose name is intimately associated with the literature of fetal pathology and teratology, dismissed the subject of cyclopia in 1905 with the acceptance of Dareste's theory. A perusal of the literature up to this date gives the impression that the question of cyclopia has been settled. Accurate and laborious experiment upon the chick embryo, however, did not solve the problem. The great respect which has been accorded to Dareste's work is not inconsistent with the belief that his deductions do not fit all cases, and do not constitute a generally acceptable explanation of cyclopia. It must be noted also that during the time when Dareste's ideas were accepted, the germinal theory of the origin of monstrosities was still in vogue. In so far as cyclopia and many other monstrosities are concerned this theory has been disproven.

In view of the newer observations on embryologic pathology and experimental teratology, of the fact that every germ cell has in it the possibility of monstrous development, as Mall (63) has said, and the fact that changes in the chemical environment of the developing embryo can lead to cyclopia, it seems appropriate to review the subject and incorporate in the ophthalmic literature the present-day conception of monstrosities which present altered eyes.

Experimental embryologists, in attempting to explain cyclopia, have been led to investigate the earliest appearance of eye-forming material in the medullary plate, with the result that important information in regard to the median position of the optic anlage has been obtained. This information deserves a place in ophthalmic literature because it comes from a reliable source, and because it is contrary to the generally accepted view of the position of the eye anlagen.

It is instructive to observe the development of eyes which are abnormally placed and thus separated from contact with the adjacent structures to which they normally bear an intimate relationship. Thus, the integrity of the ganglion cell and nerve fiber layers of the retina in the cyclopean eye of anencephalic monsters bears upon the problem of the development of the optic nerve; and the absence of a lens in an eye which is deeply seated away from contact with the surface ectoderm, and the presence of lenses developed from ectoderm in the absence of an optic cup, concern the mooted question of the self-differentiation of the lens as opposed to its dependence upon the optic cup. Therefore, the degree of autonomy possessed by certain ocular structures may be studied in cyclopean monsters in which these structures are deprived of their usual associations.

II. HISTORIC RÉSUMÉ.

Mankind seems always to have been fascinated by the appearance of monstrosities. Cyclopia has had a large share in stimulating the imagination of the ancients and encouraging both speculation and experimentation among more modern generations. Ballantyne (9), in his work on Antenatal Pathology, vol. ii., gives a picture of a Chaldean cuneiform tablet dating about 2000 B. C., with a descriptive list of monstrous births. Gravelotte (31), in the bibliography attached to his thesis in 1905, refers to the works of Homer and Hesiod in the ninth century B.C. The Greeks used the term Cyclops to describe several kinds of superman. It is a far cry from the unviable fetus with a median eye and deformed or absent brain to the giant Polyphemus and the forgers of the thunderbolts of Jove, yet the observation of nature seems to have given rise to mythologic creations. Schatz (94) suggests that the ancients deified those monstrosities which accorded best with their idea of what a god should be like, and that their ideal of beauty led the Greeks to take the least repulsive cyclops and transpose its proboscis from the forehead to the normal position and shape of a nose.

The importance attached to monstrosities in ancient Rome is indicated by the frequent references in Livy. Lease (52) has reviewed the subject and found that Julius Obsequens thought Livy's observations worthy of preservation in a book entitled *Liber Prodigiosum.* Livy apparently did not take very seriously the awful import of monstrous births, for he suggested that much of the popular talk on the subject was the product of an overwrought imagination. Indeed, the more enlightened of the ancients, as Hippocrates and Aristotle, attempted to explain monstrosities on natural grounds. Ballantyne (9) refers to Aristotle's ideas as representing the highest point of knowledge of monstrosities in 2000 years.

The period between Aristotle and the revival of learning is filled with crudity and cruelty in man's attitude towards monstrous births, which cannot be said to have disappeared altogether as yet. The various meanings attached to the word monster illustrate this state of mind. It has been derived from moneo, meaning "I warn," and monsters were regarded as a token of impending danger; to prevent this consequence they were killed and used as a sacrifice to propitiate the deities. Again, the word was related to monstro, meaning "I show," and monsters were considered to be forerunners of national disaster. This idea persisted into the seventeenth century. A monstrous birth was also regarded as a punishment for sin. The mysterious influence of the moon is indicated in the most common interpretation of the word monster as meaning "moon-calf," "calf" being a lump or swelling, as in the expression "calf of the leg." Ballantyne (8) has discussed this term from the historical and etymological standpoints (1900). Another conception was that the gods were perpetrating a joke by making abnormal creatures, as suggested in the common expression "freak of nature" and the botanical term "sport." On the supposition that evil spirits inhabited monstrous forms, these were buried alive to get rid of the spirits. No definite chronologic order can be assigned to these theories, but in general the most crude were the most ancient.

The tendency to discover natural causes as opposed to supernatural is observed in such theories as that of abnormal content or quantity of semen and of menstrual blood, and the practice of coitus during menstruation (Kickham, 48) as the cause of monstrosities. Of more importance and longer duration was the theory of hybridity, according to which monsters were the offspring of a woman and a beast. This was easily imagined because of the superficial likeness of some monstrosities to the lower animals. The punishment inflicted for this fancied crime of the mother was death, often in a revolting form. In the sixteenth and seventeenth centuries women were burned to death in France and Denmark (Dareste, 20).

While not constituting so black a page in human history as the hybridity theory, the idea of "maternal impressions" deserves condemnation. This is not merely a notion of the ignorant but is a so-called scientific theory discussed with great seriousness in medical literature. Meadows (67) in 1865 described a fetus with its anterior belly wall open which was supposed to be the result of the mother's seeing one of Aristotle's plates illustrating a case of exomphalos. Hörrmann (43), in his thesis of 1903, treated the theory of maternal impressions at length, and apparently looked upon it with favor. Even a trained observer and student of teratology like Ballantyne (7), while admitting that there were weak links in the chain of evidence in the cases which he published in 1892, concluded that the question was still sub judice.

Kickham (48), in 1912, seemed to accept the theory. Beck (11), in 1916, was unwilling to dismiss maternal impressions as a scientific theory, though skeptical himself. It would seem a quixotic undertaking to combat this superstition were it not for its cruel aspect. It accentuates the grief of mothers and other innocent sharers in accidental occurrences which imagination, aided by friends and even by the family physician, conjures up to explain the consequences of an embryonic disaster occurring before the "impression" was received and often before the mother knew of her pregnancy. Even "paternal impressions" have been brought into the discussion. Mall (63) and Stockard (114) justly condemn the American profession for holding to these superstitions in the face of the overwhelming proof of their impossibility.

Serious attempts to explain monstrosities were made by scientific students in the middle ages. Ambrose Paré (88) published a book on the subject in 1573, and Licetus (60) in 1616. Morgagni (77,78) mentioned hydrocephalus as a cause of anencephaly in his *Adversaria Anatomica* in 1706 and again in his great work (*De Sedibus et Causis Morborum*) in 1761. Marcot discussed the same thing in 1716 (Ballantyne). Harvey (32) in 1651 suggested that cleft palate is a failure of union of the two sides of the upper lip, which originally stretches as a cleft from ear to ear, a condition which is normal in the hare and camel. Here is the principle of arrested development according to which certain abnormalities in man represent the persistence of an embryologic state which is normal in lower animals and through which the human embryo should pass as it recapitulates the phylogenetic history. This theory has been emphasized more recently by Meckel (68), Fleischmann (27), the two St. Hilaires, Darwin and others.

The chick embryo has long been a favorite subject of study because of its availability and its susceptibility to malformations. The artificial hatching of chickens was practiced in ancient Egypt, where the fact that many embryos were deformed was noted. Systematic attempts to alter the development of the chick date from the elder St. Hilaire (120) who published his history of anomalies in 1836. The younger St. Hilaire (121, 122) repeated his father's experiments and made others. He observed that changes in the egg before the third day produced dwarfs or killed the embryo, while later changes produced monsters. Shaking the eggs, pricking them, keeping them vertical, partially covering them with wax and varnish, altering the temperature, and many other interferences resulted in monstrous growth. Dareste (20), following the St. Hilaires, contributed a wealth of knowledge to experimental teratology. It was not, however, until the last decade of the nineteenth century that experiment accomplished more than to establish the fact that changes in the environment of the growing embryo can lead to monstrosities. Undue importance was attached to faults in the amnion as the cause of constriction of the embryo; and the belief that most monstrosities are due to a defect in the germ cell and independent of influences operating after fecundation had the powerful influence of Meckel to sustain it. It is the recent experimental work, to be described later, which has placed cyclopia on a definite basis.

III. MODERN THEORIES OF TERATOGENESIS.

Piersol (91) has divided the modern history of teratology into three stages; the descriptive, during the last half of the eighteenth and the first half of the nineteenth century; the morphological, in which anatomico-embryologic details have been emphasized; and the experimental, including the last ten years, up to 1904 when his article was published. This third stage continued and reached its height, so far as cyclopia is concerned, in the years 1909 to 1913. It may be said that the description of the gross appearance of cyclopean monsters has been the principal contribution to the English literature, a fact which is due, in part at least, to the habit of preserving these specimens in the museums and refusing to allow their dissection. The German literature contains more of the morphologic details, with historic résumé, and theories borrowed from the French. The French philosophic tendency shows itself in classification and lucid discussion of experimental work. Much of this is outside the ophthalmic literature, and nearly all of it in England and America is to be found in the literature of embryology, anatomy, and pathology. To American science we owe the exceedingly important contributions from the standpoints of investigations in the domain of pathologic embryology in which Mall's name is preëminent, and the experimental production of monstrosities of the cyclops type by which Stockard has clarified much of the confusion attending this subject.

Modern theories of teratology logically fall into two groups; the germinal, according to which the original germ cell of one or the other parent is abnormal and destined to produce a monster; and the non-germinal, according to which the germ cells, with no inherent vice, can produce a monster if their normal development is interfered with by detrimental influences acting after cell division has begun.

1. The Germinal Theory.

The tendency of certain abnormalities to occur in successive generations of a family has led to the belief that many, if not all, monsters are due to a germinal defect. Meckel (68) advanced this theory and stated that there is no possibility of alteration in the embryo after fecundation. That this explanation applies to some types of abnormalities is generally accepted. For example, Mall (63), who was a staunch defender of the doctrine that every ovum has in it the power to become a monster if subjected to an abnormal environment, accepted albinism, polydactyly, and certain legless conditions as germinal defects. The fact that a woman who aborts a pathologic ovum is likely to do so again has been taken to support the germinal theory, though the possibility of changes in the uterus persisting through the period of several pregnancies must be considered; thus, the same environment may be responsible for the successive abortions, and not a defect in the germ cells. His (41, 42) apparently considered cyclopia a germinal defect in 1882, but later (1899) inclined against this belief.

The most plausible exposition of this theory in regard to cyclopia was given by Wilder (131) in his "cosmobion" hypothesis. He would accept a germinal origin for all departures from the usual type except those which grow out of a defect in some system of functional importance or through a mechanical hindrance or direct injury. Cyclopia is thus of germinal origin representing one stage in a series of cosmobia, an orderly sequence from an eyeless individual, through the cyclopean stage to two fused eyes in the middle line, two normal eyes in the usual positions, three eyes one of which is median and two lateral, to four eyes. These stages represent no monstrosity, but the various possibilities according to the tendency of the germ cells in obedience to certain laws. Wilder concluded that cyclopia is a cosmobion and cannot be produced experimentally. Within a year of his publication Stockard (115) announced the production of every stage in this series by modifying the chemical content of the sea water in which he grew fish embryos after cell division had begun. This was a most perfect example of a plausible theory overthrown by a stubborn fact.

2. *The Non-Germinal Theories.*

In spite of the impression made by Meckel's insistence upon the germinal origin of monsters, there have been many attempts to explain departure from the normal on the basis of factors acting upon the embryo after development has begun. These may be treated conveniently as the mechanical theory, the pathologic theory, and the embryologic theory.

a. The Mechanical Theory. This may be considered from two aspects, following Ballantyne's (9) description. Pressure may be produced from without, or may be the result of conditions within the maternal organism. External pressure may be general traumatism, as a fall or blow, or constriction of the mother's abdomen by corsets and tight clothing. Internal pressure may be divided into intra-abdominal and intra-pelvic on the one hand, and intra-uterine on the other hand. In the former, tumors, pelvic contraction and malformation of the uterus have been invoked as causes of monstrous development of the embryo. In the latter, uterine tumors, twin fetuses exerting pressure upon each other, the umbilical cord, and amniotic bands have been mentioned. The experiments of the St. Hilaires called attention to external influences acting upon the embryo. Guerin postulated muscular contractions of the uterus during convulsions, a theory which probably has no adherents now. Most of the causes assigned have been abandoned for lack of evidence of their validity; but the belief that amniotic bands are responsible for malformation through pressure upon the embryo has been warmly advocated since the time of Dareste. He found such constrictions in chick embryos and laid great stress upon this factor which has been linked, by later writers, with his theory of a premature closure of the anterior end of the neural tube as the cause of cyclopia. Ballantyne discussed the various ways in which the amnion may act unfavorably upon the embryo, by disease, by pressure, and by arrested development. There can be no question that the amnion has received undue attention. Hydramnios is frequently found in monsters, and this is precisely the opposite condition to that of amniotic adhesions to the embryo; no amniotic bands are found in most human cyclopean monsters, both the full-term fetuses and the younger ones, as can be proven by Ahlfeld's (2) remarkable Atlas. Panum's (86, 87) two fetuses, one of six weeks and the other a little older, showed no amniotic adhesions. Mall has suggested that these are secondary and not causal factors when they occur. Ballantyne's observation is pertinent, that the uterus should not be thought of as a tight case, but that it is adaptable to its environment and that the liquor amnii is a protection to the fetus. Perhaps the most potent objection to the amniotic theory is the fact that cyclopia occurs in animals which have no amnion, and these are the very species in which it is possible to produce cyclopia with regularity by experimental methods, as will be shown later.

Dareste's Theory. Especial mention should be made of Dareste's (19) hypothesis of a premature closure of the cleft at the anterior extremity of the neural tube because of the large place it has occupied in subsequent literature; and it may logically be considered in this connection because of its association with the theory of mechanical pressure upon the embryo by amniotic bands. Dareste, in an elaborate discussion of the mechanism of cyclopia in the *Annales d'Oculistique* in 1891, referred to two hypotheses, that of the "union of similar parts" by which Meckel and St. Hilaire explained cyclopia as the result of the fusion of two eyes brought about by a more or less complete atrophy of the nasal apparatus, and that of arrested development, according to which the division of the originally single median eye (Huschke, 44) fails to take place.

Dareste would explain cyclopia as an arrest of development, most frequently due to amniotic adhesions. After reviewing the evolution of the neural tube and emphasizing the incomplete closure of the two ends, he discussed the formation of the anterior cerebral vesicle and the optic outpushings therefrom. The essence of his theory is that a premature closure of the anterior end of the neural tube would produce further extension of the tube forwards and prevent the normal elaboration of structures from its wall in a lateral direction. These structures develop from ectodermal cells which occupy successively the lips of the orifice of the first cerebral vesicle, and this "sliding" of ectoderm cannot take place after the cleft is closed. It is only after the optic vesicles are pushed lateralwards that the cerebral hemispheres can develop.

Although Dareste laid great stress upon amniotic bands, he stated, in his most important work upon experimental teratology (20), that he could not explain the premature closure of the anterior orifice of the neural tube by which the eyes would be arrested in the midline and the normal development of the brain hindered. Nevertheless his theory gained adherents and was quoted with approval by later writers. Unfortunately his practical agreement with Huschke in regard to the original median position of the optic anlage was apparently ignored. Neither Dareste nor Huschke was in a position to offer substantial proof of this theory, and it is only recently that experimental embryologists have demonstrated the original median position of the eye-forming material in the medullary plate. That Dareste's explanation of cyclopia is inadequate has been shown by the discovery of cyclopean fishes with the anterior end of the neural tube open, and by the absence of cyclopia in other species which habitually exhibit a solid tube.

b. The Pathologic Theory. The modern theory that pathologic conditions in the embryo are the causes of monstrosities is foreshadowed in the suggestions of Morgagni, Marcot, and Licetus which have been mentioned. Morgagni discussed hydrocephalus as a cause of anencephaly. Ahlfeld (2) mentions the early embryos (about six weeks) of Schlegel and Rudolphi which had a dropsical vesicle in place of a brain. Förster (28), in his important work on teratology, treats in detail of fluid accumulations in the cerebrospinal canal. Beclard believed dropsy to be one of the most frequent diseases of the fetus. It is only in recent years that the pathologic theory has received much attention. The emphasis on amniotic adhesions appears in this as well as in the mechanical theory. Ballantyne (9) has classified numerous possible conditions in which various parts of the fetus may be adherent to the amnion; adhesions between different parts of the fetus, fusion of the fetus and umbilical cord, and displacement of the fetus outside of the amniotic cavity, all serve as deforming influences.

A different emphasis is found in the invaluable work of Mall (63) upon pathologic ova. From a study of 163 specimens he reached two conclusions which he considered as established beyond doubt; first, that pathologic embryos and small monsters are identical; second, that all of them developed from normal ova, due to external influences which he called "faulty implantation." His dictum, already quoted, is of great importance in the understanding of such a monstrosity as cyclopia, and is substantiated by the elaborate experimental proofs of Stockard: "every ovum possesses the power to become a monster." If the primary cause of the faulty implantation is slight the embryo may live to become a monster by being implanted correctly after the cause is removed, or poison eliminated. A more faulty environment leads to abortion. Mall considered at length various inflammatory conditions in the uterus acting upon the chorion. Endometritis causes abortions by producing inflammatory adhesions of the placenta and membranes. Hypertrophy of the decidua associated with abnormal forms of placenta is followed by arrest of development of the embryo. Atrophic endometritis means an atrophic decidua and retarded growth of the embryo. Hemorrhagic endometritis is due to a variety of infections. Hemorrhages in the chorion and placenta are often accompanied by bacteria or are due to nephritis. This may be followed by decidual infarcts and death of the embryo. While recognizing differences in opinion among the obstetricians, Mall accepted the views of Williams (134) and Ahlfeld as representative of the soundest judgment in obstetrical pathology.

Mall made use of statistics to show both the general importance of the subject of monsters and the bearing of his study of pathologic ova upon this subject. He concluded that seven pregnancies out of every hundred result in pathologic ova. One third of these give well-formed embryo monsters, going to term in about 0.6%. Thus three well-formed monsters are aborted in the early months of pregnancy to every one which goes to term. Becker (12) stated that the proportion of monstrous births varies from 1–176 to 1–4000 according as only extreme cases or slight ones are included. Most monsters are females, as has been observed universally. Von Winckel (133) tabulated 87 monsters in 12,378 births in Dresden, one to every 142 children born. There were 105 monsters in 20,000 births in Munich. Of eighty-seven monsters, twenty-three had the head involved and twelve the face. The exposed position of the head end of the embryo is given as the explanation of the preponderance of malformation in this region. Thus anencephaly occurred in 20% while spina bifida was found in 7% of a series. Panum's (86, 87) tabulation shows 16 cases of cyclopia in 618 monsters. Von Winckel (132) found 96% of pathologic ova in extra-uterine pregnancies. This goes far to substantiate Mall's idea of faulty implantation, since no germinal defect can be supposed in so large a percentage of those ova which remain in the tubes when only 7% of intra-uterine pregnancies show pathologic ova.

c. The Embryologic Theory. Harvey's idea that cleft palate is an arrested development, by which the human embyro ceases its evolution at a stage which is normal for the hare and camel, has been mentioned. Meckel emphasized this conception which accords with the well-known embryologic "law of recapitulation." Attempts have been made to explain arrested development by a failure in some tissue which is thought to dominate development. Thus, supposing that the nervous system is dominant, cyclopia would be due to an absence of the olfactory nerves. The ethmoid would not develop without the influence of the olfactory nerves, and the eyes would come together. If the medulla were absent, the face could not develop. On the supposition that the heart and blood vessels are dominant, cyclopia would result from a failure of blood supply; even anencephaly might result. Ballantyne (9) raises the question whether the small size of the internal carotids is the cause or effect of anencephaly. The possibility that some untoward influence may lessen developmental energy in the embryo is strongly suggested by recent experimental work, but there is no very great stress laid upon the theory of arrested development, in the Darwinian sense, in recent years.

IV. THE EYE IN CYCLOPIA.

Cyclopia, in the narrow sense of the word, means a single eye in the lower middle portion of the forehead. Anophthalmos and monophthalmos are not included in this definition. Cyclopia has been used in a broader sense, to include a variety of conditions in which there is more or less fusion of the eyes in a median position with incomplete separation of the orbits. A single orbit in the midline with no eye is called anophthalmia cyclopia, or cyclopia reduced to its lowest terms. The variability of the deformity is so great that, for practical purposes, it is advantageous to use the word cyclopia in its broader sense. Numerous classifications have been attempted and grades of cyclopia are mentioned accordingly. Bock's classification, quoted in the Graefe-Saemisch *Handbuch* (40), is as follows:

1. Eyes close together, each in a separate orbit; nose narrow, with a single cavity.
2. Eyes close together; two orbits; nose with a single cavity pushed out like a beak sitting on the curtailed nasal bone in the forehead.
3. One orbit; two eyes close together; scleræ joined, two optic nerves.
4. Optic nerves close together; common scleræ thinned; cornea, iris, lens, and vitreous doubled.
5. Cornea single; iris, chorioid, vitreous, and retina doubled; nerves separated by a thin layer of connective tissue.
6. One cornea; two lenses fused in the center; chorioid, sclera, retina, and optic nerve single.

Practically every conceivable degree of fusion of the various structures composing the eye has been described, and there is no great value in arbitrary classifications. The lids share but little in the deformity because of their later development and independence of that portion of the ectoderm which is very early differentiated into nervous tissue. For the same reason the bony structures of the head and face are affected secondarily. Those structures which normally develop between the eyes naturally suffer most. In the case of the lids they suffer only in so far as their median halves are fused and they are separated and retracted by an eye which is abnormally large as a general thing. There are four lids or three lids (one above and two below), bounding a lozenge-shaped space through which the eye protrudes with the cornea exposed. The horizontal diameter of this space is broader than the vertical. The lid tissues are frequently normal. The external angles are less acute than normal. The junction of the two upper lids in the midline may be inconspicuous; the junction of the lower lids is more evident and may show a caruncle. Variation in fusion of the lids has given the appearance of five lids or of one circular lid. The puncta may or may not be present. The canaliculus and tear sac usually share the fate of the nasal apparatus; the canaliculus may end in a blind sac.

The exposed surface of the eye presents a somewhat dumb-bell-shaped cornea with its long axis horizontal; one or two pupils may show through the cornea. The globe is generally shallow, because of the shallow orbit, and the posterior segment is diminished in size so that it appears as a pedicle to which is attached a broad, flattened anterior segment, the whole having the appearance of a mushroom. There is a more or less conglomerate mass of muscle tissue in which the individual muscles are made out with difficulty. The internal recti naturally do not exist. The eye is generally larger than a single normal eye, but less than twice this size; it may be smaller, and anophthalmos is a possibility. Of course, no credence can be given to reports of anophthalmos without microscopic examination of the contents of the orbit, and most of the cases reported unfortunately describe only gross appearances. Huschke (44) quoted several reports in the literature, but they were not confirmed by microscopic study. Nieden's (84) case is not convincing for the same reason. Owing to union of the eyes in the region of the fetal cleft, colobomas and colobomatous cysts are frequent. Van Duyse (24, 25) has written at length on this subject.

The various tissues composing the eye present all degrees of mal-development. They may approximate the normal, but usually they exhibit the imperfect differentiation characteristic of fetal eyes. Few cyclopean monsters come to full term and the specimens studied in man and other vertebrates are generally premature. The cornea is less sharply distinguished from the sclera than normally, having the fetal mesodermal characteristics, with poor development of Bowman's and Descemet's membranes and imperfect laying down of the lamellæ of the substantia propria. The sclera is thinner than normal. The iris may be poorly developed, the pupillary membrane retained and the anterior chamber shallow. The rest of the uveal tract may be normal; but in one eye it will usually suffer at the expense of the other, as both eyes are seldom equally developed. The retina presents rosette-like folds as in the fetal state, and generally shows greater or less imperfection in the nerve fibre and ganglion cell layers. This is especially true of the cases in which the central nervous system is greatly altered. Normal retinæ have been described in a few instances. The vitreous is usually very small, owing to the orbital deformity which causes a very shallow globe. The optic nerve exhibits all variations from a normal condition to absence of the nerve. No characteristic or habitual type can be described for any of the ocular tissues, since they vary so widely in different eyes. The more carefully studied specimens, as those of Hayashi (33), Van Duyse (24), Gabrielides (29), and Oakden (85), reveal such departures from the normal as one would expect to find in the crowded confines of the cyclopean orbit. All of the tissues tend to be more abnormal in the lower segment of the globe.

The deformity of the orbit is essentially an absence of the ethmoid bone. The orbital processes of the superior maxilla and the lacrimal bone make the floor of the orbit, and processes of the frontal, or a cartilaginous structure, make the roof. The greater part of the orbital rim is made by the zygoma, or the orbital processes of the malars and the greater wings of the sphenoid. Obviously these relationships vary according to the very variable degree of the cyclopean deformity.

V. OTHER DEFORMITIES ASSOCIATED WITH CYCLOPIA.

In order for the eyes to occupy a median position, considerable disturbance in the relations of other tissues of the head and face must take place. The most conspicuous of these is the failure of the olfactory apparatus. The nose is usually represented by a proboscis above the cyclopean eye, which the ancients regarded as a penis. This protuberance hangs from the forehead over the eye, presenting a dimple at its extremity which marks the entrance to a lumen which usually admits a probe for several millimeters. There may be cartilaginous tissue and glands in the proboscis and occasionally relics of nervous tissue, though the olfactory nerves are generally absent. The ethmoid fails, and the sphenoid is more or less in abeyance. The horizontal process of the frontal is unable to descend and remains rudimentary or absent. Dareste (19) has explained the bony abnormalities as follows: the buccal orifice is limited below by the inferior maxillary branches of the first branchial arch which arrive in contact in the median line, laterally by the superior maxillary branches which are buds from the inferior maxillary. The superior maxillary branches mount almost vertically to just below the eye, turning slightly around the anterior part of this organ to become applied and fused against the lateral parts of the fronto-nasal process. The fronto-nasal bud limits the buccal orifice above. This opening is quadrilateral. The eyes occupy the two superior angles and are separated by the whole diameter of the fronto-nasal bud. In case of cyclopia, the eye having become situated in the midline, the fronto-nasal bud cannot descend and occupy its place between the two superior maxillary branches. It remains above the eye where it is more or less modified. The superior maxillary branches cannot continue to develop. Not encountering the fronto-nasal bud, they remain below the eye and unite with each other. The buccal orifice which normally has a quadrilateral form, presents in cyclopia a triangle with the base below and the apex remains under the eye. This form of mouth is characteristic of cyclopia. The nasal fossæ are not separate but become one cavity above the eye and never come into contact with the mouth.

The anomalies of the brain in cyclopia vary greatly; they do not correspond precisely with the degree of cyclopia, since the original disturbance may affect little or much of the neural tube. The most typical changes are the absence of the olfactory system and chiasm, and the unpaired hemispheres and optic centers. The optic nerves may be absent, with a corresponding failure of the nerve fibre and ganglion cell layers of the retina. That the causative factor may operate upon the optic anlage alone is evident in lower forms where cyclopia may exist with a normal brain. Lewis (59) and Stockard (109, 115) have found this condition in the fish, fundulus. In man there is always a defective brain. Mall (64) says that the anatomical changes in cyclopia can be produced by removing the structures represented along the raphe of the medullary plate reaching from the mammillary bodies to the neuropore. The forebrain and midbrain are narrow in proportion to the union of the eyes and orbits, so that a cyclopean monster at term may have the brain of a twelve-weeks embryo. The hemispheres are single; the ventricles are fused into one cavity. Hydrocephalus is frequently present, and the skull may develop to full size as a result of the large amount of fluid even if the brain is rudimentary. Extensive failure of the neural tube to develop may result in anencephaly and absence of the spinal cord, as in the case described in this paper. Black (14), in an exceedingly valuable study of the central nervous system in cyclopia, calls attention to the varying conditions in the forebrain due to mechanical reasons not at all in accord with the degree of cyclopia. The midbrain will vary accordingly to the growth inhibition at so early a stage that it practically amounts to absence of certain tissue anlagen. Black (14) illustrated the defect in his case by the use of one of His's models of a brain at the end of the fourth week. The telencephalon is at that time a thin-walled unpaired vesicle. Marking out the areas on the ventral surface which will later develop into the corpus striatum, rhinencephalon, pars optica, and pars mamillaris hypothalamica, and cutting out the anlagen of those tissues which have not yet developed, he had left what was preserved in the brain of his specimen. Usually the brain defect is so great that human cyclopean monsters cannot live. Ahlfeld (2) says that they are not viable, though Von Hippel (40) refers to cases which lived 6 weeks, 18 months, and 10 years. Valenti (124) stated that one case lived 73 hours. The case living 10 years can scarcely be credited, unless a fairly normal individual with eyes very close together was classed as cyclopean.

Hydramnios is frequent in cyclopean as in other monsters. This is also true of heart anomalies, as shown by the edematous tissues and fluid in the serous cavities. Mall (63) would explain the marked abnormalities as evidence of not only an arrested development but an extensive histolysis and necrosis of tissues taking place in the embryo as a result of impaired nutrition.

Abnormality of the suprarenal bodies has been found in cyclopia together with absence of the superior cervical ganglia. Biessing (13) found aplasia of the suprarenals in each of 19 cyclopean fetuses, but did not find the sympathetic ganglia altered. He cautions against assuming the absence of the suprarenals which may be very small and embedded in fat.

VI. THE MECHANISM OF CYCLOPIA.

The marked bony defect in cyclopia suggested to early observers a primary fault in the osseous system with a secondary fusion of the eyes. Meckel (68), the St. Hilaires (120, 122) and Manz (65) postulated an atrophy of the nasal apparatus. Panum (86, 87) considered the failure of the ethmoid bone the essential cause of cyclopia. Dursy thought that the middle process of the frontal bone did not develop and so the superior maxillaries joined. Bock (15) suggested inflammation affecting bone and periosteum with fusion as the cause of deficient growth of the anterior part of the skull; this affected chiefly the ethmoid and sphenoid in his case.

Ahlfeld (2) called attention to the essential error of all of these hypotheses when he announced that the embryologic seat of cyclopia is the brain and not the skeleton. According to this conception, Hayashi (33) would explain cyclopia as the result of a failure of that part of the brain which bears the olfactory system. Dareste's (19) theory of the premature closure of the cleft at the anterior end of the neural tube has the virtue of calling attention to the brain rather than the skull as the primary seat of the disturbance. Becker (12), Gravelotte (31) and Ballantyne (9) accepted this explanation. Aschoff (3) questioned the narrowing of the headpiece of the amnion as a factor in the deformity of Dareste's chicks and suggested that they probably had a very early median brain defect. Hadlich expressed the same idea in regard to cyclopia. Richter stated that the originally single brain anlage does not divide in cyclopia. Taranetzky thought that the entire front part of the embryo's head is abnormal as a result of outside pressure which may be the result of a narrow amnion or of inflammatory changes. Individual cases of cyclopia furnish examples of these causative factors and one readily sees how each of the various associated deformities has impressed some observer with its importance. The secondary place of all bony abnormalities in cyclopia has gradually been established. It is desirable to go a step further and concentrate attention upon the eyes rather than non-ocular tissue. That cyclopia is not a passive apposition of the eyes because nothing comes to separate them but is a fault in the original eye-forming material is proven by the experimental work of Stockard to be described later. This work is part of the large contribution of experimental embryologists to the problem of the mechanism of such monstrosities as cyclopia, and will be discussed under the separate heading of modern experimental teratogenesis.

VII. DESCRIPTION OF THE AUTHOR'S SPECIMEN, A CYCLOPEAN MONSTER WITH ABSENCE OF THE BRAIN AND SPINAL CORD.

I am indebted to Dr. S. W. Budd, of the department of Embryology in the Medical College of Virginia for the privilege of studying a cyclopean monster which was sent to him by a practictioner. Dr. Budd generously allowed me to dissect this specimen instead of keeping it for museum purposes, and aided in interpreting the embryologic peculiarities which it presented. The histologic study was made in the laboratories of embryology and pathology in the Medical College of Virginia.

The specimen was a white, female, human fetus of 7 or 8 months with a well developed body excepting the marked anomalies of the head and back. No history accompanied the specimen and we know nothing of the parents or their other offspring. The fetus measured only 28*cm*, because of the absence of the cranium; the legs and arms were folded and the attitude of the body with a flattened head was very much like

ILLUSTRATING DR. HILL'S ARTICLE ON "CYCLOPIA, ITS BEARING UPON CERTAIN PROBLEMS OF TERATOGENESIS AND OF NORMAL EMBRYOLOGY; WITH A DESCRIPTION OF A CYCLOCEPHALIC MONSTER."

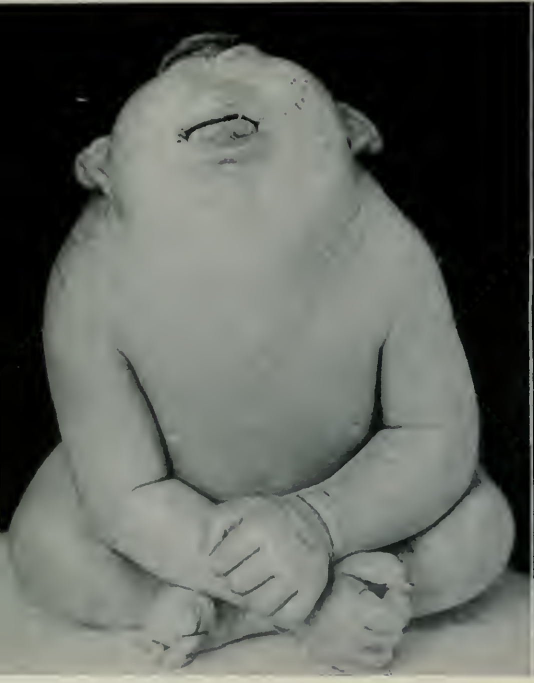

FIG. 1.

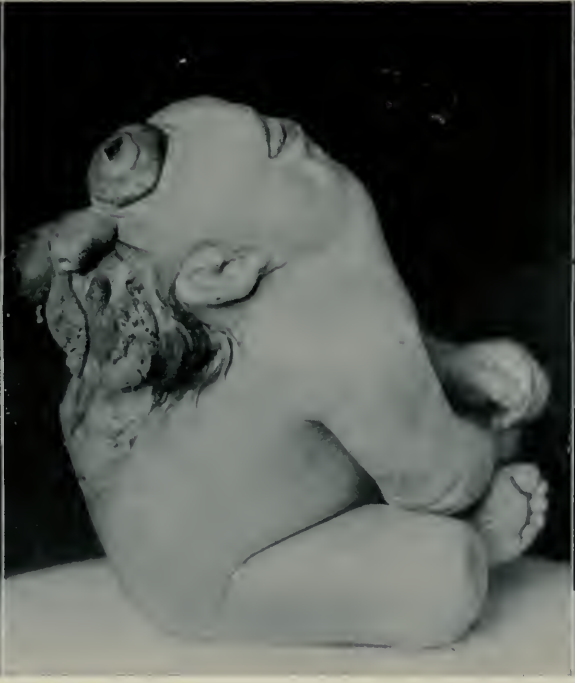

FIG. 2.

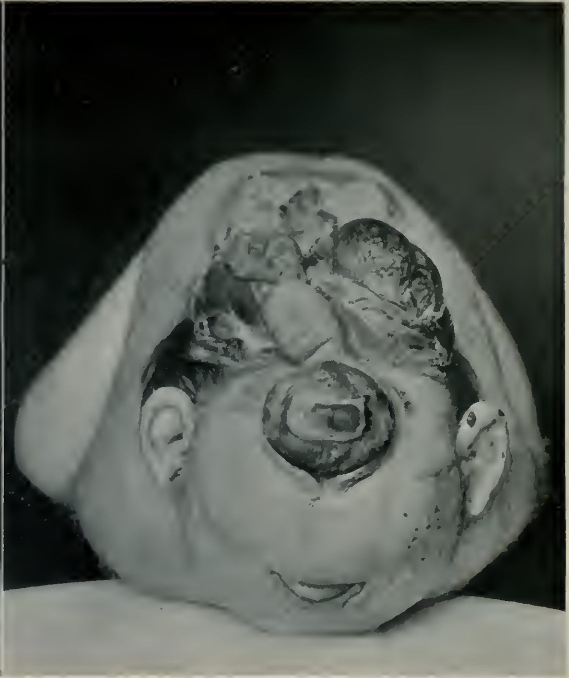

FIG. 3.

that of a frog. The head was bent backwards allowing the chin and chest to form a straight line. The mouth was open, and a large, thick tongue protruded. A large eye occupied a median position low down in the forehead, looking upward; and a proboscis lay just above and behind the eye. A fungus-like mass of dark gray substance occupied the position of the head, extending down the back to the level of the iliac crests. Between this mass and the ear on each side was a growth of brown hair. The left ear showed several dark pigmented spots; otherwise the skin was normal.

The palpebral opening was lozenge-shaped, the fissure being 12*mm* antero-posteriorly (corresponding to the vertical width in the normal position of the eye). The two upper lids were fused into one, their edges making one curved line with its convexity backward; the lower lids (anterior in this specimen) united at a rather sharp angle in the midline, making a narrow cleft. No caruncles were seen. The lids bore delicate cilia, but no trace of puncta could be discovered. The eye protruded, the lids being retracted behind the rounded border of the anterior segment of the eye which sat like the top of a mushroom upon a short thick pedicle which constituted the posterior segment of the eye. This posterior segment, 5*mm* in depth, together with the muscle cone, filled the shallow orbit, the flatter anterior segment being outside the orbit. The anterior flattened segment was practically circular, with a diameter of 28*mm* and varied in color from a deep brown to gray, to flesh color. Two corneas were made out in this exposed surface. The combined corneas measured 15*mm* by 7*mm*, the longer diameter being transverse;the right cornea was of a milky color, the left fairly transparent. A dark gray-brown, vertical band 4*mm* wide separated the two corneas. This appearance suggested two pupils and irides.

The proboscis measured 18*mm* in length, 13*mm* in width, with a constricted base 8*mm* wide attached firmly to the deep tissues just behind (above in the normal position) the orbit. Its lumen admitted a fine probe for a distance of 8*mm*.

The mass occupying the head region extended 3.5*cm* down from the base of the proboscis, had a width of 5*cm*, and protruded backwards 3*cm* from the neck. It was roughly divided into two masses, the left being the larger, which appeared to bulge from a sort of capsule. Below these masses was a grayish tissue, 4.5 x 4.5*cm* in extent, having a parchment-like feel, flattened against the spinal column, gradually fading into normal skin below and at the sides. One gets the impression that the dura was preserved in part and covered a mass of undifferentiated brain tissue. A small amount of fluid was pressed from the depths of this mass, probably formalin in which the specimen had been preserved for a long time. This entire mass was easily peeled away and revealed the practically entire absence of a skull cavity, and no spinal cord or canal, the vertebræ being represented by their bodies alone without processes or laminæ. There was a marked kyphosis in the lumbar region.

In order to obtain the contents of the orbit uninjured, the upper lids were removed with the roof of the orbit. This was very thin and small, since the orbit was extremely shallow. The posterior segment of the eye was surrounded by a mass of muscle and fat through which two superior recti, two inferior recti, and two external recti appeared to force their way. The identity of these muscles was suggested by their location; it was impossible to find any nerves supplying them, by the tracing of which to the brain one might identify the nerves and consequently the muscles. No obliques were found. The muscle tissue formed a short cone with its apex where the orbital foramen should be, and its base just behind the flattened and wide anterior segment of the eye. The orbital contents were removed together with the root of the proboscis which was firmly attached to the skin and deeper tissues immediately behind the orbit. The lacrimal glands were not found. An optic nerve-like tissue extended 5*mm* back of the eye where it was lost in the apex of the muscle cone. No optic foramen was found.

Dissection of the face and head region revealed a profound alteration in the bony framework. The mouth was well formed, the maxillæ forming upper and lower jaws with well developed gums. The tongue was large and thick, filling the mouth and protruding. The superior maxillæ were fused in the midline, not only by means of their alveolar processes to form the upper jaw, but the facial surfaces and nasal processes likewise met in the midline, so that a solid bony wall extended from the mouth to the lower orbital rim which was formed by the two maxillæ. The infra-orbital foramina were distinctly made out, each carrying what appeared to be a nerve. The floor of the orbit was made by the orbital surfaces of the two superior maxillæ. The nasal cavities were absent and there was no trace of the ethmoid, nasal, lacrimal, palate, and turbinate bones, or the vomer. The distorted shape of the orbit made it impossible to distinguish a definite roof and outer walls. The rim extended two-thirds of the way around, being deficient above; the two superior maxillæ, the orbital processes of the malars and the greater wings of the sphenoid made up the rim. The malars and greater wings of the splenoid constituted what were regarded as the outer walls. A thin bony structure, which was the only suggestion of a frontal bone, covered the back part of the orbit above the apex of the muscle cone and apparently represented a roof.

The zygoma was well developed, and the malar bones and squamous portion of the temporals were practically normal. The petrous portion of the temporals was small and the mastoid portions normal. The body of the sphenoid was distorted so that no definite sella turcica and clinoid processes could be distinguished; the lesser wings were absent. The bony development was greater on the right than on the left side. The posterior boundary of the shallow skull cavity was made by a fused mass of bone presenting a median body and two lateral processes. This could not be identified certainly as a rudimentary occipital bone or atlas, or both. Each lateral process bore an articular surface, convex below, but there was no definite articulation with the solid bony spinal column. The parietals were absent.

The thymus gland measured 28 x 18*mm* with the long axis transverse. Its anterior surface was furrowed horizontally by a large venous trunk representing the common cardinal vein and two vertical branches of this vein. The lungs were flat and contained no air. The heart was very anomalous in shape, being 39*mm* transversely and 27*mm* vertically, instead of the usual vertical, cone-shaped fetal heart. The blood vessels were normal with the exception of the greatly enlarged common cardinal vein and the disproportion in size of the two common carotid arteries, the left being much larger than the right. This fact is interesting in view of the better development of the right segment of the eye and the right half of the bones of the skull. The attempt has been made to correlate these differences in development with differences in blood supply, as has been mentioned in discussing the embryologic theory of teratogenesis.

The abdominal cavity showed the usual large fetal liver, measuring 6 x 6*cm*, normal kidneys, but no visible suprarenal bodies. Biessing (13) has warned against the assumption of absence of these bodies which may be concealed in the perirenal fat. There was evidently a great aplasia, if not absence, of the suprarenals in this specimen. No spleen or stomach was found in the abdominal cavity. A very striking anomaly above the diaphragm explained this circumstance. In a separate compartment bounded by the diaphragm below and a smaller structure similar to the diaphragm above, separating this intermediate cavity from the thorax, were found the stomach and spleen, as proven by histological examination. The spleen measured 18 x 18*mm*, being roughly divided into three lobes, the larger being twice the size of each of the others. Apparently this anomaly represents a failure of descent of the pleuro-peritoneal membrane which is one of the structures destined to enter into the formation of the diaphragm, so that the stomach and spleen lay between two leafs of the diaphragm.

The Levaditi stain of liver tissue showed no spirocheta pallida, nor was there other evidence of congenital syphilis. The peripheral nervous system was normal except for the head region.

(*To be concluded.*)

NEUROPATHIC KERATITIS SETTING IN LONG AFTER ALCOHOLIC INJECTIONS INTO GASSERIAN GANGLION FOR RELIEF OF TRIGEMINAL NEURALGIA.[1]

By Dr. BURTON CHANCE, Philadelphia, Pa.

IN recent years surgeons have boldly attempted to relieve neuralgia of the trigeminus by the resection of the nerve branches; by the extirpation of the Gasserian ganglion; and by the direct destruction of the ganglion through the injection of coagulating fluids, notably alcohol, into the ganglion. Such procedures sometimes have led to serious complications through interference with the nutrition of parts supplied by these nervous structures. The following communication in which are the outlines of a case which presented to me unusual clinical features, I trust may not be found uninteresting to those whose day's work is more varied than my own.

On December 24, last, I was consulted by a man of 45, who stated that on arriving at the railway station in Cleveland, Ohio, on the night of December 1, he found the sight of his left eye to be greatly blurred and the lids and the globe most uncomfortable. He believed that a cinder had lodged on the eye, yet, he was not capable of judging accurately because in the past two years the eyeball had been markedly anæsthetic consequent to a series of operations on the trigeminal nerve, on the left side, as well as upon the Gasserian ganglion. In the succeeding days the symptoms continued without abatement, and he returned to Philadelphia.

The patient declared that he had never had an injury nor disease of either eye, but in recent months he had had in mind the need for presbyopic correction glasses. He gave an interesting history of the surgical treatment of trigeminal neuralgia, confined to the left side, from which he had suffered persistently for many years. He had had several teeth extracted; repeated operations upon his nasal structures; the resection of the supraorbital and of the infraorbital nerves; all ineffectually, but he was finally relieved by alcoholic injections into the Gasserian ganglion, for, in February, 1917, alcohol was injected into the ganglion at the hands of Dr. Charles H. Frazier. From that time he had been entirely free from pain, although singularly uncomfortable, because of the anesthesia of the regions supplied by the trigeminus.

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[1] Read at meeting of American Ophthalmological Society, 1920.

I found on examination slight conjunctival, but quite distinct pericorneal injection of the globe, with only scanty lacrimation. The corneal surface was œdematous and without sparkle. There was no apparent loss of substance, and on a closer inspection, it seemed to be pervaded by fibrillar scars. The membrane was totally anæsthetic to the touch of a wisp of cotton. There were no evidences of herpetic formation. A tiny mass, presumed to be a foreign substance, proved to be only a collection of mucus.

The iris was not inflamed although it reacted to light sluggishly. The fundus was visible in spite of the obscuration of the cornea; there was nothing worthy of note therein, the nerve head being healthy. The visual acuteness of the right eye equalled $\frac{6}{7.5}$ and of the left $\frac{6}{60}$.

I instilled solutions of atropine and holocaine and prescribed a preparation for frequent use in the ensuing 48 hours, and then applied a light patch-bandage.

On December 26th, the eye was quite free from injection, both superficial and deep, yet the corneal œdema had increased, and quite obscured the deeper structures. On the next day the œdema was less, but there were diffused throughout the cornea illy defined hazy spots. It was possible to see the fundus faintly and V = $\frac{6}{25}$. Two days later the epithelium for nearly the whole extent was found to have been exfoliated and the entire membrane was intensely edematous. Dionin was instilled and the lids were sealed with strips of plaster. Two days later the œdema had subsided, and, V = $\frac{6}{12}$. Two days later there was no œdema, and the exfoliated area had become filled in at the nasal half, but there was a strange horizontal streak, like an old cicatrix, in the anterior layer of the substance. At no time was there infection of the denuded area.

At the end of the 10th day after consulting me he was so comfortable that I consented to his going back to Cleveland to attend certain important business engagements. On January 8th, he reported that he had had no discomfort except when he read for a length of time; but on January 11th, he wrote that the eye had become inflamed and was uncomfortable and that the lids were puffed, in spite of his having worn the light bandage constantly. I wired that he should consult Dr. William Bruner; who informed me that he had found on the 15th a greatly congested eye; the cornea of which appeared to have been denuded entirely of its epithelium. Yet, by the 19th, the epithelium became restored and only a central cloudiness was present. He prescribed a mild antiseptic ointment and had applied a light compressive bandage. Because of the general history, the signs were at first sight most alarming, and he was for a time considerably worried as to the possible outcome of the case.

In the meantime I learned from Dr. Frazier that "at the University Hospital in April; again in May, and again in June, 1916, he had injected alcohol into the ganglion without relief in the first and second instances, but following the third there was relief for two days. On January 29, 1917, he attempted to inject the third division of the nerve and through it the ganglion, which maneuvers were without success as he failed to reach the division. On February 5, 1917, he resected the supraorbital branch, and on February 19, 1917, he resected the infraorbital branch of the trigeminus, and on February 28, 1917, 1.5*cc* of alcohol was successfully injected into the ganglion by the Härtel technic." The man declared to me, at his first visit, that from the last date, he had been entirely free from neuralgia, although the sight of his left eye had lost its acuteness after this last injection. It was not possible for me at my first examination to obtain satisfactory visual tests because the cornea was so clouded.

He is a tall man with a hollowness of his left cheek, the skin of which is "moth eaten" and the tissues scarred, which scarring followed the healing of the resection of the infraorbital nerve; and, there is a quite broad linear cicatrix in the superciliary line, from the removal of the supraorbital. In the tracts embraced by the nerve there is complete anæsthesia to the points of the esthesiometer. The anaesthesia is limited to the left side without crossing the median line; the limitation being marked in the manner one observes in zona ophthalmicus, and extends to the ala and tip of the nose. The skin of the scalp, forehead, and face is scaly and exfoliates persistently. There are no pareses of the ocular muscles, but there is a lack of tone in the external angle of the mouth so that sometimes there is dribbling.

On January 23, 1920, the patient returned wearing the bandage which had been applied by Dr. Bruner. I found that the epithelium had become restored although there was edema of the cornea and a central cloud which on magnification consisted of a curious latticing beneath Bowman's membrane. The separate strips were of approximately equal breadth, but each end was slightly tapering. These lines were made up of fine grayish white dots, and all were surrounded or bathed, as it were, in a bath of tiny granules.

On this date I prescribed tablets of chromium sulphate, gr. iv, to be taken four times a day. I bathed the eye in warm sterile water, and instilled atropine and holocaine. The lids were then sealed and a light compress was applied. This treatment was cautiously repeated daily. By January 30th although the membrane had cleared greatly, there was still a central denudation, but the latticing was not so pronounced as it had been. The clearing continued; but when examined four days later, the epithelium was again seen to be cast off. For the next ten days the lids were kept sealed after a daily morning dressing, so that by February 13th the epithelium was again restored, although there was a "guttate edema" with faint lines as described above. Dionin powder was dusted on and by February 17th the eye became white again, the corneal surface restored, and the edema completely subsided. Because of a slight discomfort, on awaking, which I adduced to an irritation of the cornea caused by the first opening of the lids, the patient was advised to wear a patch-bandage at night. On February 28th the eye was quiet, and except for a small central haze it was so healthy that $V = \frac{6}{15}$. At the end of March, $V = \frac{6}{7.5}$ despite an amorphous, yet translucent haze. The fundus was found to be entirely healthy. The chronium tablets which had not been taken for three weeks, were again prescribed. On May 11th, after an interval of twenty-one days, the eye was found to be entirely well and was seen to be free from all symptoms except a faint superficial haze; $V = \frac{6}{7.5}$; that of the right $\frac{6}{10}$.

The history here cited is based upon frequent examinations in which were used such magnifying instruments as were available. The corneal manifestations were such as I had not seen before, by this I mean, any case exhibiting such extensive denudation followed by restoration after so short an interval. There was nothing suggestive of herpetic formation, yet I regarded the process to be analogous to herpes. The repetitions of the intense edema were as alarming as the subsidence of it was astonishing. The picture of the deeper manifestations I had no recollection of having ever seen. The fine grayish dots which seemed to pervade the stroma, superficially, and the formation of the lattice were of absorbing interest. The latticing I considered to be the lymph spaces of the cornea, and the grayish dots to be colloid material circulating through the stroma. The latticing was not at all comparable to the fine twigs one sees in dendriform keratitis. There were no localized necrotic areas to hold the fluorescin, indeed the stain was easily washed away. Giri, in his report of a case of indolent ulcer, before the Ophthalmological Society of the United Kingdom, last year, described a quite similar formation. At my examination a day or two ago there was present only a faint superficially interstitial haze. It is remarkable that the iris continued so little affected.

The length of time intervening before the onset of the keratitis in my case is remarkable; from February, 1917, to December 1, 1919, is indeed a long delay for trophic changes to set in after such treatment as this man was given. The injection was without doubt so sufficiently effective as not only to relieve the distressing tic but also to have rendered the cornea anesthetic. Of course, it is not known for how long in a given case the influence of the alcohol can last, nor has it been settled by post-mortem studies, I believe, just how great is the destruction of the ganglia. Little or much as an injection might destroy, the alcohol certainly renders the nervous tissues susceptible to any disturbing factors during the period of influence of the toxic element. In my case in the period succeeding the last injection the man was in what he believed to be perfect health. His teeth were not diseased, nor were his tonsils; his nasal cavities had been subjected to thorough examinations and were considered to be not diseased. It might be that a cinder or other foreign particle lodged on the cornea which by irritation had excited the reaction. But I am not inclined to view the reaction as external in origin; on the contrary, I believe it to have been caused by tropic changes arising in the nervous supply to the cornea.

I admit that it might be disputed that the keratitis was directly dependent upon the injection of alcohol into the ganglion. It is true that branches of the trigeminus had been resected and that more than one injection had been given, but all unavailing and after none of these had there been untoward symptoms. It remained for the final injection to affect cutaneous sensibility, reduction of lacrimation, and corneal anesthesia. I am, therefore, led to ascribe the symptoms to destructive processes in the ganglion itself produced by the alcohol.

Not until this case came before me had I had any personal contact with one who had had an injection of alcohol into the nervous ganglia. As it is not unlikely that there are others of this Society who have not had such cases, it might be worth while to state that probably Härtel's report of twenty-seven cases treated, in Bier's clinic, by injection of alcohol into the Gasserian ganglion, has stimulated surgeons in America to the performance of this delicate yet comparatively simple operation. The procedure has been so recently introduced into surgery that but little data has accumulated. In personal communications from Drs. Cushing, Frazier, Sharpe, and Adson, of the Mayo Clinic, the procedure is regarded as dangerous and certainly likely to lead to such serious complications as ulceration of the cornea. The advocates of the direct alcoholization of the ganglion, on the contrary, consider it to be equivalent, as far as the immediate physiological effects are concerned, to the extirpation of the ganglion, yet without the dangerous sequels of a ganglionectomy because the effects are gradual in their development. New Orleans surgeons, including Matas, Maes, Allen, Nix, and others who practice the method freely, offer it as a means of curing tic douloureux. They declare it to be devoid of the usual dangers accompanying intracranial operations on the ganglion. In twelve cases Allen found no evidences of inflammation of the eyes. The trophic lesions have been found to be not so pronounced as those which follow removal of the ganglion. Because the cornea becomes anesthetic after a successful injection, ulcerations are not unlikely to occur. Härtel, after his first ten injections saw two develop keratitis, and Maes had one in whom a leukoma developed, which cleared up later. Allen mentions cases as having occurred in his experience. So far as it has been possible for me to search the literature I have not found any description comparable to the case here detailed.

Härtel's results show that destruction of the ganglion must have been fairly complete, not even considering the cases of neuroparalytic keratitis. In his 27 cases reinjections were rarely necessary. The period of relief averaged 8 months. Bruner has had a case which was relieved for a few years; on the recurrence of the pain the ganglion was removed, but the eye continued sensitive and irritable. Allen is convinced that when the value of injections for the relief of neuralgia is recognized they will be used extensively. In my own case although two unsuccessful attempts were made, the relief the patient has had for three years since the third was given has been so great that he regards his recent affection as merely a discomfort and the result as justifying the procedure.

REFERENCES.

MAES. "The Treatment of Trifacial Neuralgia by the Intraganglionic Injection of Alcohol (Härtel's Method)." New Orleans, *Med. & Surg. Jour.*, vol. lxvi., 1913–1914, p. 183. "Surgical Treatment of Tic Douloureux." *Int. Abst. of Surg.*, 1915, xxi., p. 358.

HÄRTEL. "Die Behandlung der Trigeminusneuralgie mit intrakraniellen Alkoholeinspritzungen." *Deutsch. Ztschr. f. Chir.*, 1914, 126, p. 429.

BECKMAN. *Mayo Clinic Papers.* 1916. Vol. viii., p. 733. (Excellent bibliographies are given in these works.)

TRANSIENT HERPETIC RASH OVER THE AREA OF DISTRIBUTION OF THE OPHTHALMIC BRANCH OF THE FIFTH NERVE FOLLOWING APPLICATION OF BLUESTONE IN A CASE OF PARINAUD'S CONJUNCTIVITIS.

By Dr. MATTHIAS LANCKTON FOSTER, New Rochelle, N. Y.

A BOY, 14 years old, presented a typical picture of Parinaud's conjunctivitis of his left eye. The upper fornix was distended by a turgid mass of acuminate growths, the apices of several of which were yellow. The conjunctiva passed smoothly over all of these, with the exception of one, the yellow apex of which was ruptured. Nothing resembling pus could be obtained either from this, or from other yellow apices. The left preauricular gland was swollen and firm, the left parotid and submaxillary glands swollen to a less degree. The left tonsil and the cervical glands on both sides were swollen and remained unchanged throughout the attack. Microscopic examination of a portion of the mass of acuminate growths showed a loose fibrous connective tissue matrix very densely infiltrated with small round cells and polymorphonuclear leucocytes.

A few days later bluestone was applied in the hope of reducing the turgescence of the conjunctiva. This application was immediately followed by a rash resembling a fresh attack of herpes over the left side of the forehead, sharply delimited by the median line. The skin, up to the edge of the hair, was reddened, swollen, and presented a considerable number of papule-like elevations, but there was no pain and no hypersensitiveness of the skin. The scalp was not unduly sensitive to rubbing and pulling of the hair. Two hours later this rash had completely disappeared.

Three days later the conjunctiva was less turgescent. Another application of bluestone was followed by a less marked rash in the same situation. The skin was elevated slightly, but distinctly, above the level of the skin on the

> other side of the forehead, with a very plain line of demarcation, and was covered by little elevations with much less redness between them. Another application after an interval of two days was followed by a slighter reddening and thickening of the skin, and subsequent applications during the next week were followed by perceptible eruptions over the same area, each less observable than the preceding; then they ceased to appear. During this last week there appeared, and persisted between applications, a patch of thickened and scaly skin over an approximately triangular area on the forehead, its apex at the brow just over the left inner canthus, each leg about 5*cm* long, its vertical leg not quite coinciding with the median line. This disappeared spontaneously in about a week. During this time the turgescence of the conjunctiva steadily grew less, and its diminution seemed to proceed with equal steps with the lessening of the skin reaction. The patient was under observation two and a half months longer, while the disease took its usual slow course to recovery without suppuration of the glands. Although several attempts were made to again excite a reaction of the skin by an application of bluestone, no such reaction could be again discerned.

This case is reported because of the peculiar reflex effect produced on skin supplied by the ophthalmic branch of the fifth nerve as the result of an irritant applied to the filaments of the same nerve in the conjunctiva. At least, that is my interpretation of the phenomena observed. These phenomena were a fugitive herpetic rash, which on no occasion lasted two hours, and a dry eczema, which lasted about a week. My knowledge of cutaneous affections does not qualify me to discuss such conditions discursively. It is my impression that transient attacks of eczema have been met with, and that eczema has occasionally been ascribed to a reflex origin, but if I have ever read of such a fugitive herpetic eruption as the one just described, the fact has escaped my memory.

Satisfactory answers have not yet been obtained to two questions: If this was truly a skin reflex induced through the medium of the fifth nerve, why was not the skin hypersensitive? Did the turgid condition of the conjunctiva predispose in any way the conjunctival filaments of the fifth nerve to the excitation of a skin reflex, or was its diminution *pari passu* with that of the skin reflex merely a coincidence?

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. C. BERENS, Jr., Secretary.

DR. A. E. DAVIS, CHAIRMAN.

A meeting of the Section on Ophthalmology was held at the New York Academy of Medicine on Monday evening, May 17, 1920.

PRESENTATION OF PATIENTS.

Dr. L. W. Crigler presented a case of **unilateral postural exophthalmos.**—A. S., male, age 34, was first seen on March 23, 1920. His chief complaint was severe pain and protrusion of the right eye whenever he bent his head forward or stooped over; as long as his head was held upright he was all right. He first noticed this condition about two years ago. Previous to that time he had suffered from recurrent attacks of nosebleed for several years. There has been no recurrence of the nosebleed since the exophthalmos began.

Two years ago he had an attack of jaundice which lasted about one month, followed by complete recovery. Once or twice during the past two years he has lost consciousness for a few minutes at a time; his general history is otherwise negative.

A most thorough physical examination failed to elicit any abnormality, aside from a slightly dilated vein on the anterior faucial pillar on the right side.

Nothing was revealed by means of the X-ray although radiograms were taken of the head, neck, and thorax. The gall bladder was likewise negative.

Blood Wassermann and chemical blood were both negative.

The eyes in their normal position show no difference in degree of protrusion but by having the patient bend his head forward between his knees for a half minute there is a gradual protrusion of the right eye; measured on the exophthalmometer this equals as much as four or five *mm*. The tissues surrounding the eye, as well as the temporal vein, become distended.

Vision, refraction, and fields in both eyes are normal.

Ophthalmoscopically the fundus picture does not change during the protrusion although the patient states that his vision is temporarily slightly obscured. The patient experiences no head noises nor can pulsation or bruit be detected at any time.

Diagnosis: Varicosity of the orbital veins.

Ætiology: Undetermined.

Prognosis: Favorable as to retention of vision.

Treatment: No operative measures advised as long as further symptoms do not develop.

Among the several causes advanced in explanation of this unusual condition, that of Birch-Hirschfeld seemed most plausible, namely, the presence of a retro-sternal goiter interfering with the return flow of blood to the heart.

An anomalous cervical rib, sometimes advanced as a cause, was excluded by means of the X-ray.

Dr. George H. Bell demonstrated a patient with **embolism of central artery of the retina** on which he performed an early paracentesis. The patient, age 28, came to see him March 12, 1920, stating that while combing her hair that morning she noticed that she suddenly lost the sight of her right eye. Dr. Bell saw her about two hours after the accident. The ophthalmoscopic examination revealed the fundus picture of embolism of the central artery.

There was marked arterial anæmia of the retina. The white, cloudy, œdematous looking opacity appeared at the posterior pole and gradually extended over the entire fundus. The fovea centralis retained its normal color, appearing as a "cherry red spot." The arteries were very small. The veins were reduced in size and the optic disk was pale. The pupil was widely dilated and did not react to light. T. was N. The patient had light perception only.

There was no time for delay, so Dr. Bell did a paracentesis of the cornea at once in his office. The A. C. filled so rapidly that it was emptied for the second time after which a pressure bandage was applied. The treatments after the operation consisted of massaging the eyeball once daily and nitroglycerin internally.

Ætiology: The patient has a presystolic murmur, and Dr. Bell believes that a vegetation from the mitral valve caused the embolus. The patient's blood pressure is normal; urine normal; X-ray of teeth, neg.; Wassermann, neg.

The fundus has now, two months afterwards, returned to its normal color, and there is an atrophy of the nerve. The markings of the lamina cribrosa are invisible, indicating that the atrophy is of retinal origin. The arteries are very small, but not the white bloodless cords that we generally see following embolism.

The pupil now reacts to light. Vision, fingers at five feet.

Dr. Crigler said that he had seen the patient before and after the paracentesis and believed the operation had aided in the restoration of vision.

Dr. George H. Bell demonstrated a patient with **thrombosis of central vein of the retina** in a man, age 32. He first saw this man on February 2, 1920, when he said he could not see with his left eye.

He had been working for the Government for the last ten years. His lunch every day consisted of sweets—milk, chocolate, cakes, and pastry. The patient had been on this diet for a long time, not knowing that sugar was a toxic substance. When he was first seen, V. O. D. = $\frac{20}{20}$; V. O. S. = light perception. On examining the fundus of O. S., the outline of disk was obscure. The entire fundus was covered with blood. An almost continuous sheet of blood extended over the disk and to the temporal side. The veins were enormously distended and buried in the swollen retina, except in places where there were venous loops. The arteries were all obscured.

Tension of eye was 20*mm*. Urinalysis showed 3.1% sugar, no albumin, with sp. gr. 1030. X-ray of teeth, negative; examination of cardio-vascular system was negative; Wassermann was negative. Tonsils had been enucleated. A chemical examination of blood at P. G. Hospital showed urea n. 11.9, creatine 1.9, sugar .182.

This patient had a thrombosis. It was possibly caused by the action of the sugar on the endothelial cells.

Statistics confirm the increasing prevalence of diabetes as the consumption of sugar increases.

Now, at this time, two months later, a great many of the hemorrhages have been absorbed leaving behind some white areas. Some of the veins are still distended. There are some fine vessels of new formation on the disk.

Dr. Bell demonstrated this patient for two reasons: first, that a thrombosis in a man 32 years of age is very rare and also it is unusual to find diabetes in a man of his age; second to demonstrate the effects of the diet on the eye even in the young. V. O. S. = Hand movements at 10 feet. V. O. D. = 20:20.

Dr. A. J. HERZIG read a report of a case of **cavernous sinus thrombosis** in a child of five years.

The child had had no previous history of infectious disease or illness that he could ascertain; except that she complained of a headache occasionally during the past year. Patient became ill on February third complaining of headaches. Temp. 102° which later came down to 101.2° and after that fluctuated between these degrees where it remained until February 8th, when it went to 104°. Two pediatrists saw the child daily and treated the patient symptomatically until February 8th, when a swelling at the outer and upper side of the right eye was first noticed. Dr. Herzig saw the patient first on February 8th. In addition to the ocular findings a right otitis media was present. Child semiconscious at this time. Right exophthalmos, right eye, fundus showed dilated veins. Left eye, fundus negative. He incised the right tymphanic membrane and then incised the orbital abscess. He obtained a drop of a dark-brown fluid which upon culture showed staphylococcus citreus. He felt he was dealing with a retro-bulbar abscess with origin in the ethmoid region. He had intended to operate upon the nose the following day. That evening the temp. having risen to 106°, the child was removed to St. Luke's Hospital where he entered the orbital cavity and broke down all the bone in the ethmoid region. It was not until he reached the posterior cells that he encountered pus which he drained into the nose. The culture from this pus subsequently showed the staphylococcus citreus. The temperature at the time of operation was 107.2°. On February 9th at 1 a. m. the temperature dropped to 102.4° and later rose to 108.8° when he was again summoned and redressed the wound at the same time gently curetting the wound and removing a few blood clots and debris. At 8 a. m. the eye was almost completely proptosed and the cornea was cloudy. X-ray at this time showed the posterior ethmoid region cloudy and also the space left by the removed bone. Blood culture at this time showed 125 colonies of staphylococcus citreus to 1cc. Blood count showed 25,000 cells, 80% polymorphonuclear leucocytes, 20% lymphocytes. Urine examination showed only a faint trace of albumen. At this stage the patient showed all signs of meningitis for the first time. A spinal puncture showed a cloudy fluid under considerable pressure and later culture demonstrated two colonies of staphylococcus citreus, 2800 cells positive butyric, 90% polymorphonuclear leucocytes and 5% lymphocytes. Dr. Wiener in consultation diagnosed the case as one of cavernous sinus thrombosis, all signs of a paralysis of the 3d, 4th, and 6th nerves and anæsthesia of the cornea being present. There was anæsthesia of all branches of the first division of the 5th nerve. The patient died at 10 p. m. the same day without regaining consciousness. The case is interesting in the fact that it occurred in a child of five years, and also that from the time the eye became proptosed until death took place only 30 hours had elapsed.

Dr. W. P. EAGLETON said we do not operate early or radically enough in sinus thrombosis as we usually mistake it for orbital abscess. They are generalized infections with infected blood current. If the blood culture is positive the eye should be enucleated and the cavernous sinus opened. If this is done, there is some hope for recovery.

Dr. JOHN GUTTMAN in reporting a case of **macular hole in the retina** said: "A patient, H. R., came to me with the history that he could not see with the left eye. Subjective examination of the left eye showed a total loss of vision. Ophthalmoscopic examination showed a round red disk the size of the papilla, in the region of the macula lutea, simulating an effusion of blood with very sharply defined border. The bottom was dark red. He attributed the cause of his affection to a fall from his bicycle when the opposite side of his head, *i. e.*, the right side, struck the pavement. The injury of his eye was therefore caused not by a direct blow on that eye, but by contre coup."

Dr. B. W. KEY presented a patient with **penetrating wound of the eyeball** with infection treated by **anti-diphtheritic serum.**

W. D., 42 years of age, February 25th was struck in the right eye by a sharp piece of metal, which penetrated the cornea, iris, and lower margin of the lens. He was sent to the Infirmary at once. X-ray was negative. In 48 hours infection was evident, the lids swollen, violent conjunctival and iritic reaction, purulent exudate in anterior chamber, and apparently a similar involvement in the vitreous. Pain was intense. Subsequently the anterior chamber was filled with purulent exudate so that the pupillary space was obscured.

His treatment was limited to hot bathing and 2000 units of anti-diphtheritic serum every three to four days while at the hospital, which was about two months. There was early relief of pain (in 48 hours). After the first violent onset of the infection, the eye gradually quieted till it now presents a painless, mildly inflamed globe, tension a trifle sub-normal, a cataractous lens, a clear and transparent anterior chamber and pupillary space.

While vision is hopelessly lost and it may become necessary later to remove the globe, the behavior of this infection is very unusual, and quite significant of the systemic effect of anti-diphtheritic serum in combating severe ocular infection.

Dr. W. E. LAMBERT said, regarding the use of anti-diphtheritic serum in ocular infection that he had seen a number of cases in which it would seem that the use of the serum had had a decided, beneficial effect, but it is impossible to say whether or not the same result may not have been obtained with the usual treatment, without the serum. It is therefore difficult to say how much real benefit the use of the serum is.

Dr. KEY presented another patient with **bullet wound of both orbits** with unusual complications.

Mrs. J. P., aged 50 years, consulted him April 17, 1920, and gave a history of being shot through the right eye, with sudden loss of vision in the left eye one month before. The right eye was removed a few days after the accident and she was discharged from the hospital after three or four weeks.

On examination there was a deeply notched scar of the right upper lid, the orbital tissues and conjunctiva drawn toward the nasal side of the orbit. The left eye appeared entirely normal except that the pupil was slightly dilated and reacted sluggishly to light.

The ophthalmoscopic examination revealed a fairly clear vitreous, but a profuse retinal hemorrhage completely covering the papilla, and extending nasalward, upward and downward for a distance of about three discs diameters. The macula region was clearly visible, but marked by early atrophic changes. Vision was limited to fingers at five feet nasalward. An X-ray revealed the bullet in the left maxilla at the lower temporal angle of the bony orbit, also numerous small portions of it in the tissues of left orbit behind the globe.

This case is presented because of the interesting character of the injury, also for a diagnosis and prognosis.

Dr. K. Schlivek reported a case of **oxycephaly.** N. J., age 28 years.

No other member of the family had skull deformities.

Cannot get history of early life (parents are dead). Went to Hebrew school at five years and was through at thirteen; apparently the same mental development as the other boys in his town. Then started to work in a dress-goods store and from that time remembers he had difficulty with colors. At twelve years of age he knew that O. D. was blind. At fourteen years he came to this country and worked as an errand boy. Is quite as capable at his present work as the other men are but finds great difficulty with colors.

Patient came to Dr. Wheeler's clinic at the New York Eye and Ear Infirmary. Chief complaint is inability to distinguish colors.

Exam. V. O. D. Fingers at six inches. O. S. $\frac{20}{20}$. There is exophthalmos; measured with Hertel's exophthalmometer 23mm each eye. Divergent strabismus O. S. and this is concomitant. There are no paralyses and no nystagmus.

Fundi O. D. nerve head is white, margins are irregular, physiological cup is fuzzy. Slight narrowing of the arteries and there is some perivasculitis. O. S. nerve head is white except for a little faint pink in the nasal part, margins are irregular, physiological cup is fuzzy.

Fields O. D. show very marked concentric contraction and no color perception; it is difficult for the patient to fix. O. S. slight contraction of fields for form; marked contraction for blue and no perception of red or green.

Head is of the characteristic oxycephalic type. Vertical diameter very high, side to side and antero-posteriorly, diameters are small. Forehead is high and slopes slightly backward. Measurements—fronto-mental 19cm. Nasion to chin 12½cm. Biparietal 14¾cm. Occipito-frontal arc (nasion to opisthion) 15½cm.

X-ray by Dr. Dixon.

Has well-developed frontal sinuses. Neither the frontals, ethmoids, nor antra are clear as they should be. Nasal septum is deviated to the left. The sella is large and of the semi-inclosed type. It measures 10 x 18.5mm and the square content is 194 sq.mm,—all corrected. It lies very low, the dorsum being but a short distance above the level of the auditory canals.

The orbits are foreshortened apparently, rather than actually, the approximate distance from the glabella to the chiasm being 50mm while the angle of the roof to Reid's baseline is about 28°.

The inner table of the skull shows very distinct markings of the convolutions of the anterior lobes, and the anterior portion of the parietal.

The distance between the optic foramina (as near as can be estimated from the plates) is 21.5*mm.*

General and neurological examinations are negative.

Wasserman and urine are negative.

This is a typical case of Oxycephaly and has the characteristic symptoms, the skull deformity and the optic atrophy. It also shows the most common accessory symptoms, exophthalmos and divergent strabismus.

In these cases there is a premature closure of the sutures in the posterior portion of the skull and this allows the brain to grow and expand only in the direction of the anterior part of the skull. There is increase of intracranial pressure, with its choked disc and later secondary atrophy. In the stage of development there very often are headaches and convulsions. This condition is much more common in males than in females 5:1.

The family history generally is negative although there are few cases reported in the same family. Intelligence is generally unimpaired unless blindness hinders the development.

Prognosis: The condition will not progress.

Treatment should be directed to the alleviation of the intracranial pressure during the stage of development *i. e.*, before the seventh year.

Dr. W. P. EAGLETON reported a case of **pulsating exophthalmos** with **ligation** of the **ophthalmic vein.**

Dr. A. E. DAVIS presented a patient with **bilateral glioma.**

Bertha C., aged 17 months, was seen by him for the first time May 15, 1920. The mother gave the following history of the case. Healthy child at birth, at three months of age noticed that the left eye "looked like a cat's eye in the dark." Consulted an oculist who advised enucleation but this was refused. Two months later, the right eye was similiarly affected as the left. Mother has done nothing for the patient. Present condition of the patient: Right eye: Interior of eye is half filled with yellowish white mass with blood vessels in the mass; at one point there is a "flame-like" or "sheet" of blood vessels on the anterior surface of the glioma. Pupil active and quick perception of light. Tension normal. Left eye: The entire fundus is filled with a yellowish white mass with blood vessels in it. Pupil somewhat sluggish to direct light action. Whole eye slightly enlarged, especially at the equator. Tension somewhat increased. Child is fretful and cries at night. As it is too late to operate mother was advised to try Selenium under Dr. C. H. Walker's direction. The mother has lost one other small child with "cancer of the eye" of eight months' duration.

PAPERS OF THE EVENING.

Dr. DERRICK T. VAIL read by invitation a paper on **detachment of the retina.** (Appears in full in this issue.)

A paper on **further experiences with trephining and aspiration in retinal detachment** was read by Dr. EDGAR S. THOMSON (appears in this issue).

DISCUSSION: DR. ARNOLD KNAPP: Detachment of the retina is a very timely topic, for there is no subject in ophthalmology in which we require more knowledge and newer ideas. Dr. Vail has reviewed a number of important and fundamental facts and has given us some interesting and stimulating deductions. The idea of a peripheric choroiditis being the cause of detachment of the retina is plausible. We know that the region of the ora serrata is a vulnerable one, and that in extraction of foreign bodies from the back of the eye incisions through this part of the eyeball are very apt to be followed by detachment. The neighborhood to the ciliary processes also explains the frequency of iritis in detachment of the retina. On the other hand peripheric choroiditis which is so strikingly seen in inherited syphilis is not usually followed by detachment of the retina. The rôle of the aqueous arrest is interesting, though, I fear, theoretical, and I am free to confess my inability to follow a discussion on osmosis.

Dr. Vail's views on treatment are conservative and justly critical. He apparently does not object to sclerotomy, trephining, or subconjunctival salt injections, and believes that the favorable action of these procedures must be due to their influence upon osmotic phenomena. I am very glad to agree with and confirm Dr. Vail's views that the advance in the treatment of detachment of the retina must necessarily depend upon further knowledge of the chemistry and physiology of the vitreous body.

Dr. J. H. CURTIN said that Dr. Vail spoke of the importance of the ætiology or the underlying condition causing retinal detachment; that the condition of retinal detachment was a symptom as much as an iritis, choroiditis, or any other local eye condition; that it is simply a local manifestation of a general systemic condition in the majority of cases; that in the study of our cases the underlying condition should always be diligently sought for but that in nearly all were we baffled in our search.

Urine and blood examinations, focal infections including the examination of the sinuses, teeth, tonsils, gastro-intestinal tract, stomach, and fecal examinations were made and in only one case could we definitely state the underlying conditions, that being the case of chronic interstitial nephritis.

We have obtained some results in the treatment of retinal detachment by scleral trephining and aspiration while all other measures have been failures in our hands, and until some better means are given us we will continue in our operation in selected cases.

Dr. W. E. LAMBERT stated that his experience with the trephine operation for detachment of the retina had been most disappointing, as in none of the cases has the result been other than temporary. The only cure he had was one of spontaneous reattachment, which occurred some months after a cataract extraction. The patient was kept in bed for several weeks after operation was made and no result obtained. Six months later she presented herself with the complete reattachment and restoration of the function. This has remained so for the past five years.

Dr. A. E. DAVIS: Dr. Vail states that in those patients in which the retina reattaches, there is always a white line of demarcation at the junction of the healthy and the formerly detached retina. I wish to confirm this observation so far as it applies to one of the only two cases of detachment of the retina in my experience which have become reattached. This patient, a young man eighteen years of age, gave a history of a fall from a cradle when a child. When seen by me he had detachment of lower half of the retina in the left eye and a white line horizontally across the fundus demarcating the attached portion of the retina from the detached portion. The patient remained under my care for eleven years without any change taking place in the detached retina, either as to increase or decrease. He was then sent to the country on account of apical tuberculosis. He returned to the city six years later greatly improved in general health, having gained thirty pounds in weight, and to my surprise with a complete reattachment of the retina. The white connective tissue line or band still demarcates the attached and reattached portions of the retina; but in addition the temporal side of the retina has two supplemental white bands just below the original band and parallel with it.

Dr. THOMSON in closing stated that he wanted to lay particular stress upon the importance of the aspiration. It was almost possible to tell from the ease with which the fluid was aspirated what the final outcome of the case would be. If the fluid comes out well, there is some chance of success; if the retina does not go back into position properly but remains pouched and wrinkled the chances are poor. He agreed with Dr. Vail that the search for the underlying cause of detachment of the retina was most important.

REPORT ON THE PROGRESS OF OPHTHALMOLOGY FOR THE SECOND, THIRD, AND FOURTH QUARTERS OF 1919.

Edited by Matthias Lanckton Foster, M.D., F.A.C.S.,
New Rochelle, N. Y.

I.—GENERAL OPHTHALMIC LITERATURE.

1. Duane, A. **The eyes of the signalman.** *American Journal of Ophthalmology*, August, 1919.

2. Fison, A. H. **Positions of focal lines of a small cylindrical beam of parallel rays traversing the center of a thin symmetrical double convex lens.** *British Journal of Ophthalmology*, June, 1919.

3. Greenwood, A. **The organization and activities of the ophthalmic service in the American expeditionary forces.** *American Journal of Ophthalmology*, August, 1919.

4. MacCallan, A. F. **Causes of blindness in Egypt.** *Ibid.*, October, 1919.

5. Maddox, E. E. **Venesection as a preventive for expulsive hemorrhage.** *Ibid.*, January, 1920.

6. Moreau, F. **Hysterical amblyopia.** *Annales d'oculistique*, clvi., 3.

7. Panni, N. P. **The " Tecnomyopic " test for simulators or those who exaggerate amblyopia.** *Ibid.*, clvi., 4.

8. Van der Hoeve, J. **Eye lesions produced by light rich in ultraviolet rays. Senile cataract, senile degeneration of the macula.** *American Journal of Ophthalmology*, March, 1920.

9. Wiener, M. **School of ophthalmology at Camp Greenleaf.** *Ibid.*, May, 1919.

Duane (1, **The eyes of the signalman**) after two years' experience in the training of men in signaling concludes that the American flags could be improved if the blues and reds were lighter and the yellows deeper. The ocular requirements should be considered in connection with other physical and mental qualifications. Men otherwise fit, with uncorrected vision of $\frac{20}{40}$ or less, might be accepted since glasses are only a relative handicap.

ALLING.

GREENWOOD (3, **The organization and activities of the ophthalmic service in the American expeditionary forces**) presents an authoritative history of the ophthalmic service including a description of the various hospitals, the character of the cases treated, the optical department, and suggestions as to the improvement of the service. A list of the personnel is appended.

ALLING.

FISON'S paper (2, **Positions of focal lines of a small cylindrical beam of parallel rays traversing the center of a thin symmetrical double convex lens**) is a *bonne bouche* to the mathematically inclined but is *caviare* to the general reader. It is not suitable for abstraction and would be incomprehensible without the diagrams.

T. HARRISON BUTLER.

From statistics compiled by MACCALLAN (4, **Causes of blindness in Egypt**) we learn that out of 85,000 cases examined during seven years who were blind in either one or both eyes 73% of the eyes were lost as the result of conjunctivitis. He states that the most frequent form is acute conjunctivitis without further explanation and that trachoma is not a frequent cause of blindness. Glaucoma caused 11% and cataract 7.7%.

ALLING.

MADDOX (5, **Venesection as a preventive for expulsive hemorrhage**) was obliged to operate upon a patient who suffered from malaria, gout, and myœdema and had lost an eye from intraocular hemorrhage following a cataract operation. After giving quinine, a laxative, and thyroid extract he opened a vein in the temple and pricked the episcleral veins before operating. A successful result was obtained.

ALLING.

PANNI (7, **The "Tecnomyopic" test for simulators or those who exaggerate amblyopia**). The patient reads the Snellen chart with his good eye, then the vision is gradually reduced by holding increasing strengths of plus spherical lenses and the results recorded. Having established for the good eye a table of how much diminution of vision is produced by increasing strengths of plus spheres, the author proceeds to the examination of the supposedly amblyopic eye by the same method. The answers are recorded and the examination repeated the next day if necessary. Comparing the findings in both eyes and at different examinations will prove the veracity or mendacity of the patient.

SCHOENBERG.

MOREAU (6), describes a case of hysterical amblyopia in a woman who underwent a severe mental shock during a bombardment.

SCHOENBERG.

VAN DER HOEVE'S (8, **Eye lesions produced by light rich in ultra-violet rays**) line of reasoning is ingenious. By experimentation light rich in ultra-violet rays has been shown to produce opacity of the lens, changes in the posterior layer of the iris and ciliary processes, as well as degeneration of the retina and choroid. The lens absorbs light of short wave length producing phosphorescence and diffusion of light throughout the lens, thus reaching the posterior surface of the iris and the ciliary body. Cataract is produced by lack of nutrition due to the disturbance in the ciliary body. Lenses differ in their ability to absorb these rays, hence in some individuals they reach the macula and cause degeneration. Macular degeneration therefore does not occur in cataract cases. Cataracts occur in India, where the light is intense, about ten years earlier than in Europe. Would it be possible to attribute gray hair, arteriosclerosis, and general loss of vitality of the body cells in senility to ultraviolet rays?

ALLING.

This paper by WIENER (9, **School of ophthalmology, Camp Greenleaf**) gives details of the schedule and actual work of the camp school.

ALLING.

II.—RELATIONS OF OPHTHALMIC TO GENERAL DISEASES. POISONS.

10. BARKAN, H. **Ocular angioneurotic œdema and glaucoma.** *American Journal of Ophthalmology*, November, 1919.

11. BELL, G. H. **Relation of teeth, tonsils, and intestinal toxæmias to diseases of the eye.** *Journal American Medical Association*, Oct. 11, 1919.

12. CLAPP, C. A. **Detachment of the retina in eclampsia and toxæmia of pregnancy.** *American Journal of Ophthalmology*, July, 1919.

13. Conlon, F. A. **Conjunctivitis due to food anaphylaxis.** *Ibid.*, July, 1919.

14. Craig, J. A. **A case of poisoning by homatropine.** *British Journal of Ophthalmology*, June, 1919.

15. Desai, H. M. **A case of congestive glaucoma after the use of homatropine and eserine.** *Ibid.*

16. Dickinson, W. G. **Ocular manifestations of cerebral syphilis.** *American Journal of Ophthalmology*, February, 1920.

17. Fisher, J. Herbert. **Migraine.** *British Journal of Ophthalmology*, June, 1919.

18. Fradkine, S. **Two cases of concentric contraction of the visual fields without hysteria.** *Clinique ophtalmologique*, viii., 3.

19. Gallemaerts. **Ophthalmic zona.** *Annales d'oculistique*, clvi., 3.

20. Luna, R. P. **Ocular lesions consecutive to injections of antityphoid vaccine, keratitis herpetica febrilis.** *American Journal of Ophthalmology*, July, 1919.

21. Luna, R. P. **Disturbances of vision in patients harboring filarial tumors.** *Ibid.*, November, 1919.

22. Moret. **Ocular disturbances in ictero-hemorrhagic spirochetosis.** *La clinique ophtalmologique*, viii., 1.

23. Penichet, J. M. **Ocular complications of peripheral epilepsy.** *American Journal of Ophthalmology*, August, 1919.

24. Taylor, J. **Changes in the sella turcica in family optic atrophy.** *British Journal of Ophthalmology*, May, 1919.

25. Terson, A. **Ocular diseases of buccal origin.** *La clinique ophtalmologique*, viii., 2.

Barkan's (10, **Ocular angioneurotic œdema and glaucoma**) patient was a woman of 52 who suffered from frequent attacks of angioneurotic œdema of the face. In connection with some of these attacks she would complain of dimness of vision and congestion of the eye. The œdema lasted no longer than an hour and the tension decreased promptly under eserine. After seven years the eye showed no permanent changes. He attributes the phenomenon to a localized œdema of the uveal tract.

Alling.

Bell (11, **Relation of teeth, tonsils, and intestinal toxæmias to diseases of the eye**) emphasizes the importance of these causes of eye inflammation. He thinks that sugar is a solid alcohol and aids fermentation in the stomach leading to the formation of toxins.

Alling.

Clapp (12, **Detachment of the retina in eclampsia and tox-**

æmia of pregnancy) relates six cases of retinal detachment which he observed at the Maryland Lying-In Hospital during the past year and a half. The condition is a rare one if one were to judge by the absence of recorded cases, but he believes that more thorough examinations would show that they are fairly frequent. The lesions varied from small peripheral elevations to almost complete detachment. In all these cases the retina has become reattached although the ultimate vision may be defective on account of the injury produced by the neuroretinitis. The detachments were undoubtedly due to the transudation of fluid under the retina and were not accompanied by tears.

ALLING.

CONLON (13, **Conjunctivitis due to food anaphylaxis)** is convinced that certain lesions of the eye especially conjunctivitis, are produced by food to which the individual is sensitized.

In one case the eyelid became swollen and the conjunctiva hyperemic whenever the patient ate strawberries or tomatoes. Even the use of tomato catsup had the same effect. Another patient seemed to be troubled only when he ate eggs and still another after indulging in flounders. He recommends the protein skin test which consists in applying various proteins to skin abrasions and noting the local reaction which, when positive, appears as an urticarial wheel surrounding the cut.

ALLING.

CRAIG'S (14, **A case of poisoning by homatropine)** instructive case history runs as follows: A. B. æt. 3½ was refracted under atropine which in 1% solution was instilled twice daily for three consecutive days. There were no toxic symptoms. Two years later homatropine was employed, the child being 5½ years old. A drop of 1% solution was instilled into each eye. Two hours later the child was in a state of intense mental excitement with visual hallucinations. She complained of a dry mouth. The excitement continued for ten hours when the child fell asleep and awoke normal five or six hours later.

T. HARRISON BUTLER.

A reminder that the use of a mydriatic in the middle-aged is not free from danger is always salutory, the more so when some ophthalmologists advise the routine use of a cycloplegic for refraction. DESAI'S (15, **A case of congestive glaucoma**

after the use of homatropine and eserine) case is as follows: Mrs. S. B., æt. 48, was refracted after the instillation of a 1% solution of homatropine. Eserine in 1% solution was employed before the patient left. The refraction was plus 4.5 D. The same night severe pain came on, and three days later she returned with acute glaucoma the tension being 45 Schiotz units. Eserine failed to control the tension so an iridectomy was performed. This operation was only partially successful the tension remaining at 25. A sclero-corneal trephining reduced the tension to 15. The refraction was reduced by the operation to 2.5 D. and the vision from $\frac{6}{6}$ to $\frac{6}{18}$. The refraction was still 2.5 six months later.

The reviewer has had two similar cases after the use of homatropine followed by eserine. In one case the tension was not reduced by sclerectomy, and the eye was eventually lost. In the other glaucoma developed in both eyes, both were trephined but in only one was the sight saved.

T. Harrison Butler.

Dickinson (16, **Ocular manifestations of cerebral syphilis)** states that most cases show at some time in their course, ocular palsies of the external muscles and pupillary changes. Ataxia without ocular paralysis may be observed. Anomalies of the field of vision are common often showing reduction of the temporal fields. The media are usually clear but retinitis may occur and optic nerve changes are quite constant varying from mild neuritis to choked disk. Alling.

Fisher (17, **Migraine)** who has been a life-long sufferer from migraine suggests that alterations in the pituitary body may be the cause of the disease, and the line of reasoning that he develops lends strong support to the interesting hypothesis. The classical symptoms of the disease are the scintillating scotoma, the typical headache, and the final vomiting. In addition Fisher himself notices that the attacks are always accompanied by a slow pulse and by polyurea. There is also an extreme feeling of depression. The scotoma is often associated with hemianopsia. In the female the attacks often coincide with the catamenia and cease during pregnancy, they tend to disappear at the climacteric. In the male, too, the disease commonly terminates at about fifty when the sexual functions are becoming inactive.

The migraine spectrum is always symmetrical; it may be represented by a scotoma spreading from the central point of vision; it may first appear in the temporal halves of the fields, or may affect homonymous halves of the retina. If flashing light sensations appear homonymously they will be followed by hemianopsia in the half fields implicated.

Fisher thinks that these sensations could be produced by irritation of the nerve fibers at the base of the brain. Implication of the chiasma would explain the expanding central scotoma, and the bitemporal scotoma. Affection of the tract would cause the homonymous spectrum. There is only one region, the interpeduncular, where pressure could cause these varied effects. Fisher suggests that swelling of the pituitary body is the mechanical agent which causes the irritation of the nerve fibers, and points out that alterations in the pituitary secretions would account for the other symptoms. The enlargement of the gland would in addition raise the intracranial pressure and give rise to the headache, the vomiting, and the slow pulse.

At the menstrual epoch, the climacteric, and during gestation, the pituitary body is profoundly affected, hence the liability to an attack during menstruation and the termination of the disease when the sexual functions fail. The increased renal activity too is explained upon the same grounds for the pituitary secretes a hormone which stimulates the kidney to increased secretion. Fisher has examined the sella turcica by the X-rays with negative results.

Fisher is not the first surgeon who has connected the pituitary body with headaches. Irving H. Pardee of New York (*Archiv. Internat. Medicine*, February, 1919) makes a similar suggestion and his line of argument is similar to Fisher's. He, however, states that the sella turcica is generally found by Roentgen ray examination to be altered in various ways.

T. HARRISON BUTLER.

FRADKINE'S (18, **Two cases of concentric contraction of the visual fields without hysteria**) first patient had a marked visual field contraction of the left eye with no other findings to explain its cause. A careful examination revealed that the patient was a malingerer. The second case had contraction of the visual fields, reduced acuity of vision and marked asthenopia by reading. A neurologic examination showed the existence of a mild meningitis (increase of globuline and white cells in the spinal fluid). The gradual subsidence of the meningeal process was followed by a complete disappearance of the ocular symptoms.

SCHOENBERG.

GALLEMAERTS (19, **Ophthalmic zona**) reports a case of this nature met with in a child five years old.

SCHOENBERG.

LUNA (20, **Ocular lesions consecutive to injections of antityphoid vaccine**) observed a case of herpetic keratitis following a catarrhal inflammation of the upper air passages from which the patient entirely recovered. Three years later he was given a polyvalent antityphoid vaccine and within two days developed superficial ulcerations of the cornea with anæsthesia. The author reviews our knowledge of the subject of ocular reactions following the use of the vaccines and concludes that no lesions can be said to depend exclusively upon the injections but herpes may develop, especially if there is a predisposition. The vaccines may also light up an old iridocyclitis and it is well to avoid the injections in luetic, tuberculous, and rheumatic patients who have had lesions of the uveal tract. Some cases are evidently purely coincidences.

ALLING.

LUNA (21, **Disturbances of vision in patients harboring filarial tumors**) describes a condition of the cornea in these cases which he attributes to toxins produced by the filaria and absorbed into the system. The lesion consists of minute deposits in the anterior layers of the cornea extending from the periphery toward the center but never including the pupillary area. The opacity is so dense that it resembles the sclera. Removal of the tumors, which are usually in the scalp is the only remedy.

ALLING.

MORET (22, **Ocular disturbances in ictero-hemorrhagic spirochetosis**) describes these disturbances as follows: (a) In the acute period of the disease there is a congestion and sometimes hemorrhages in the conjunctiva and uvea. Acute iritis is not an unfrequent occurrence. (b) In the period of decline the patient complains of asthenia and the ophthalmoscope reveals retinal anæmia or neuroretinitis.

SCHOENBERG.

PENICHET (23, **Ocular complications of peripheral epilepsy**) reports the case of an epileptic who had only a few sensations of light before his attacks and a contraction of the fields following, but after every fit there was a profuse hemorrhage into the anterior chamber and subconjunctival ecchymosis. The blood disappeared completely in from 20 to 30 days. Another case showed paresis of the orbicularis with ptosis and complete anæsthesia of the skin in the infraorbital region. These disappeared regularly after each seizure.

ALLING.

TAYLOR (24, **The sella turcica and family optic atrophy**) brings forward two more cases which help to support Fisher's theory that Leber's disease is dependent upon changes in the region of the pituitary body. Leber in his original paper published in 1871 noted the occurrence of familial optic atrophy in patients who were subjects of nervous symptoms, such as headache, vertigo, tremors, and even epileptic attacks. Also that the optic atrophy was not infrequently preceded by some degree of optic neuritis, and that while central scotoma for color and failure of central vision were characteristic, contraction of the fields was rare. Fisher pointed out that it was difficult to maintain the theory that Leber's disease was caused by a retrobulbar neuritis. Taylor's two cases were brothers who belonged to a family which has furnished several cases of Leber's disease. Observations on these cases were published by Taylor and Holmes (see *Trans. Ophth. Soc. U. K.*, vol. xxxiii). The paper contains a skiagram of the sella turcica region of both patients and they reveal characteristic changes in the sella turcica which is long and shallow with alterations in the clinoid processes. One X-ray picture was taken within a few months of the onset of symptoms. Taylor holds that these examples uphold Fisher's theory for in each the sella turcica is not normal.

T. HARRISON BUTLER.

TERSON (25, **Ocular diseases of buccal origin**) calls our attention to the errors we are prone to make when diseased teeth coexist with an eye trouble. Without denying the ætiological importance of dental infections, the author is rather inclined to believe that there is a link between the eye disease and the tooth process, and that link is a "dyscrasia" or "diathesis" which predisposes the ocular tissues to the localization of the infection. The logical conclusion is to treat the general condition at the same time we attempt to eradicate the focus of infection.

SCHOENBERG.

(*To be continued.*)

NOTICE.

ROYAL LONDON OPHTHALMIC HOSPITAL.

(MOORFIELDS EYE HOSPITAL)

CITY ROAD, E.C. 1.

Patrons, HIS MAJESTY THE KING.
HER MAJESTY THE QUEEN.
HER MAJESTY QUEEN ALEXANDRA.
President, HIS ROYAL HIGHNESS PRINCE ARTHUR OF CONNAUGHT.

This Hospital, established 116 years ago, and best known throughout the civilized world by its popular name "The Moorfields Eye Hospital," is the parent of all similar institutions throughout the English-speaking world.

In 1811, Dr. Edward Delafield and Dr. J. Kearney Rodgers, then young men who had recently graduated in medicine at the College of Physicians and Surgeons in New York, came to London and studied at this Hospital under Dr. Farre and Mr. Benjamin Travers. On their return to their own country in 1818, so impressed had they been with all they had seen and learnt at the London Eye Infirmary, as it was then called, that they determined to establish a similar institution in America. This they succeeded in doing, and in August, 1820, "The New York Eye and Ear Infirmary" commenced the great and beneficent work which it continues to carry on at the present time.

In 1816 Dr. Edward Reynolds came from Boston, Mass., to London to pursue his medical studies. He attended the practice and lectures at this Hospital under Mr. Benjamin Travers and Sir William Lawrence. On his return home he found his father blind from cataract in both eyes. With rare courage, fortified by his recent experience in London, he decided to operate. Happily the operation proved a complete success. It had never been undertaken in Boston before. It led to the foundation of Dr. Reynolds's reputation as the leading surgeon in diseases of the eye, and to the foundation in 1824 of "The Massachusetts Charitable Eye and Ear Infirmary," which still exists as a center of light and leading.

Ever since these fathers of Ophthalmology in the United States came to study at this Hospital there has been a continuous succession of American medical men working in its wards, its operation theater, its out-patient department, and its laboratories.

Nurses, like medical men, who are engaged in the treatment of diseases of the eye require special training beyond that which is provided for them in their ordinary curriculum. Moorfields Hospital aims not only at supplying all that is required for training Ophthalmologists but also to supply suitable training for Ophthalmic nurses. Many nurses who have received such training at this Hospital have gone from it to take up similar work in various parts of the British Empire and America.

Immense progress has been made in Ophthalmology since the Hospital was first established, and much of this has been effected by the researches of the many distinguished surgeons who have served on its staff.

Many further advances are ripe for investigation in several different directions, but can only be carried out if the necessary means are forthcoming. Work such as this benefits not only one class, one community, or one nationality, but the whole of the human race.

Moorfields Hospital feels that, in view of what it has already accomplished and what it is striving to do in the future, it is justified in appealing for the necessary funds not only to the British but also to the American public.

It asks then for contribution towards a fund of £100,000 for the following purposes:

(*a*) To enable it to extend its laboratory accommodation for purposes of clinical and pathological research.

(*b*) To supply adequately paid assistants to the Honorary Medical Staff, which will liberate them from much of the routine work which they now have to perform, and allow of them devoting more of their time to clinical instruction and research for which they are so eminently qualified.

(*c*) To supply adequate accommodation for the nursing staff, not only those who carry on the general work of the Hospital but also those desirous of obtaining a special training in the nursing of cases of diseases of the eye.

ARTHUR FREDERICK,
President of the Royal London Ophthalmic Hospital.

CORRESPONDENCE

541 WELBECK STREET,
CAVENDISH SQUARE, W. 1.
September 20, 1920.

To the Editor of THE ARCHIVES OF OPHTHALMOLOGY.

DEAR SIR:

Will you allow me to correct a misunderstanding that may arise from a remark made by Dr. Charles Maghy in your July issue?

Dr. Maghy states "In a recent letter from Colonel Elliot asking him for his statistics to compare with other authors, and those of the Moorfields Hospital, he was unable to furnish the same." I have the most elaborate notes of every single case that I have trephined since I left India, with fields, tonometer tracings, etc. I was, however, reluctantly obliged to express my inability to furnish statistics to Dr. Maghy for the simple reason that I was at the time busy on my book on *Tropical Ophthalmology* which has just appeared. This took up every minute of my spare time, and I much regret that I could not see my way to drop it, in order to analyze my statistics of glaucoma. To have undertaken such an analysis would have meant a very considerable amount of labor, for I should never be content to issue statistics for publication until I had gone into the matter very carefully indeed. With regard to my Indian statistics, Dr. Maghy knows that they are published very fully in chap. 11 of my second edition of *Sclero-Corneal Trephining*.

I am not for one moment suggesting that Dr. Maghy meant to mislead your readers; on the contrary, I am sure he had no such intention; but as the statement stands at present, it might be misunderstood, by those who do not know the true facts of the case.

I would like to add that it was with great regret that I had to refuse Dr. Maghy's flattering request, and that simply for the reason given. I explained my difficulty fully to him in the letter he mentions. If I were to accede to all the very kind invitations of the same nature that reach me, I should be obliged to put to one side the very large mass of material which I have accumulated in my tropical work, and which will still take me several years to deal with.

Yours truly,

R. H. Elliot, M.D., F.R.C.S.,
Lt. Col., I. M. S., Ret.

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